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ABSTRACT

Five case studies were conducted to collect empirical evidence on innovative mechanisms through which universities worldwide manage their relations with industry. Cases were selected from institutions of higher education in Israel, Papua New Guinea, Turkey, Brazil, and Uganda. These studies were selected for their innovative approaches, but also because they represent a wide range of development contexts. Taken together, the studies confirm the hypothesis that relations with industry have developed considerably over the past decade in all analyzed institutions. The scope of such relations is widening to embrace new types of linkages and new modalities for their implementation. The studies illustrate the variety of options the institutions have with regard to policy-making and organizational development. Chapters of this book are: (1) "Introduction"; (2) "YISSUM, the Interface for University-Industry Partnerships at the Hebrew University of Jerusalem, Israel" (Moshe Vigdor); (3) "The Management of University-Industry Relations in Papua New Guinea" (M. A. Satter and J. Pumwa); (4) "The Management of University-Industry Relations: Experiences of Bogazici University, Turkey" (Okyay Kaynak); (5) "The Management of University-Industry Relations: The Case of the University of Sao Paulo, Brazil" (Guilherme Ary Plonski); and (6) "The Management of University-Industry Relations at Makerere University, Uganda" (Avitus Tibarimbasa and Eriabu Logujjo). (Contains 6 figures, 12 tables, and 21 references.) (SLD)



**Improving the managerial effectiveness
of higher education institutions**

The management of university-industry relations

**Five institutional case studies from Africa,
Europe, Latin America and the Pacific region**

Moshe Vigdor

M.A. Satter and J. Pumwa

Okyay Kaynak

Guilherme Ary Plonski

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International Institute for Educational Planning

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LIST OF ABBREVIATIONS

AVU	Audio Visual Unit
BUVAK	Bogaziçi University Foundation
CECAE	Executive Co-ordination for University Co-operation
CECU	Civil Engineering Commercial Unit
CPD	Continuing Professional Development
CYCOOP	Ibero-American Network of Company-University Co-operation Management
CYTED	Ibero-American Programme of Science and Technology for Development
EC	European Community
ESALQ	Agriculture School
ESU	Electronic Services Unit
FAPESP	Programme of State of São Paulo Foundation for the support of research
FCAV	Fundação Carlos Alberto Vauzolini
FINEP	Financiadora de Estudos e Projetos (Funding Agency of the Ministry of Science and Technology) (São Paulo)
FUSP	Fundação de Apoio à Universidade de São Paulo
GADI	Group to support the development of inventions
GCEP	Gatsby Centre for Enterprise Promotion
GDP	Gross Domestic Product
GNP	Gross National Product
HUJ	Hebrew University of Jerusalem
ICL	Israel Chemical Industries Ltd
IFTA	Insect Farming and Trading Agency
IPEN	Institute of Nuclear and Energy Research
IPR	Intellectual Property Rights
IPT	Institute of Technology Research
MDC	Management Development Centre
MEDA	Mediterranean Development Area
MIT	Massachusetts Institute of Technology

NAL	National Analysis Laboratory
NGO	Non-Governmental Organization
PNG	Papua New Guinea
PNGLAS	Papua New Guinea Laboratory Accreditation Scheme
PNGUT	Papua New Guinea University of Technology
R&D	Research and Development
RFH	Rainforest Habitat
RQF	Regional Qualification Framework
SIMPI	Union of Small Industries in the State of São Paulo
SME	Small and Medium Enterprise
S&T	Science and Technology
TDF/	Technology Development Foundation
TTGV	
TECO	Technology Consults Ltd (Makerere)
TQM	Total Quality Management
TUBITAK	Scientific and Technical Research Council of Turkey

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**THE MANAGEMENT OF UNIVERSITY-INDUSTRY RELATIONS
FIVE INSTITUTIONAL CASE STUDIES FROM AFRICA,
EUROPE, LATIN AMERICA AND THE PACIFIC REGION**

Editor

Michaela Martin

INTRODUCTION

The issue of university-industry relations has gradually emerged in the discussion on reforming higher education systems and institutions as a strategy to improve the relevance of their teaching and research activities. The proponents of this strategy have also widely benefited from the fact that public resources for higher education have been diminishing over the past 10 years or so due to a movement of expansion of higher education systems, economic crisis and shifting priorities between social sectors and within the education sector itself. As a consequence, resources from the private sector and from services offered to enterprises, are increasingly viewed as an alternative source of funding for higher education institutions.

Simultaneously, university-industry linkages have increasingly been seen in a favourable light by governments, given the importance of high-level continuous professional development and technological innovation for the competitiveness of national economies. As a consequence, national governments in many countries have put in place a great number of incentive mechanisms, such as tax alleviation or deferments or matching grants in selected technological domains. The role of government in the stimulation of university-industry linkages is now perceived to be of crucial importance.

The term 'university-industry linkages' covers a wide variety of realities. The term 'university' is used in this study in its generic sense to cover all types of higher education institutions, not only the traditional research university. The same is true for the term 'industry', which comprises all public and private enterprises. It is also true to say that 'university-industry linkages' cover a wide array of different realities. Big research universities may be linked to major high-tech corporations for top-level R&D projects. At the other end of the spectrum, a small

regional university may be collaborating with a small or medium-sized company and provide technical assistance to upgrade existing technology or to identify training needs to improve staff competences through a continuous professional development programme.

For the sake of classification, the following broad categories of linkage mechanisms, both pertaining to teaching and research activities, have been identified in this study:

- (i) consultancy (conducted on a formal or informal basis);
- (ii) teaching and curriculum development (such as sandwich courses, jointly developed degree courses, continuing education courses of short, medium and long duration, exchange of staff, etc.);
- (iii) R&D activities (including contract research and co-operative and sponsored research initiated and administered by internal or external structures), some of which lead to the setting up of so-called spin-off companies involved in capitalizing on research discoveries and inventions, assisting faculties in commercializing their R&D expertise and in providing business-development assistance to entrepreneurs involved in these activities;
- (iv) others (such as regular mutual visits, jointly organized meetings, conferences and seminars, joint publications, joint participation in exhibitions and fairs, industrial support to individual students or their associations, industrial representation on the governing boards of higher education establishments, etc.).

By the late nineties, the existence of relations between higher education institutions and industry had become a common and widely acceptable phenomenon. At the end of the millennium, information on such successful joint ventures is easily available as part of an information

and communication strategy conducted by these institutions. However, it is much more difficult to obtain information on the formal and informal mechanisms through which institutions manage such relations. A professional management of university-industry relations is nowadays believed to be a crucial success factor for the development of sustainable collaboration. Professional management of university-industry linkages includes the following aspects:

- (i) internal or external interface structures (organizational development) which are in charge of managing university-industry linkages, in particular their organization, staffing, modes of operation and legal status as well as their control through the alma mater;
- (ii) procedures of financial management: financial autonomy in the deployment and utilization of resources, costing of projects, distribution of generated income, existence of risk capital;
- (iii) procedures of personnel management: status and salaries of personnel collaborating in projects; development of skills and attitudes in staff for their collaboration in industry, incentives for the motivation of staff to collaborate in projects with industry; policies on the use of staff time in industry-related projects;
- (iv) management of intellectual property: existence of policies and procedures for the development and management of patents and other intellectual properties.

1. The research project

The main objective of the research programme for which the five attached case studies were prepared was to collect empirical evidence on innovative mechanisms through which universities worldwide manage their relations with industry. Since management practices and procedures depend very much on local circumstances, such as opportunities for collaboration depending on the economic environment and enterprise structures, but also on internal policies and a particular institutional culture, it was decided to collect the empirical evidence through a case study design. Such a design would also allow to present information on such structures and procedures taking into account the particular external and internal context of the chosen institutions.

As a consequence, the IIEP identified and launched 12 case studies inviting institutional managers of or those active in university-industry relations to document innovative approaches used in the area of organizational development, financial and personnel management and the management of intellectual property, at institutional, departmental and programme levels, among which the attached five cases were selected. Such an applied approach was chosen to make available practical advice and options to other managers of programmes with industry regarding structures and processes whose appropriateness needs to be discussed in the light of specific institutional contexts. The case studies were produced and finalized during 1998 and 1999.

From the 12 case studies launched under the research project, the following five case studies were selected:

- Hebrew University, Israel
- Papua New Guinea Technical University
- Bogaziçi University, Turkey
- University of São Paulo, Brazil
- Makerere University, Uganda

They were selected for their innovative approaches in the management of their university-industry linkages, but they also represent a wide range of development contexts, such as a western industrialized country, middle-income countries and a low-income country, as well as different academic traditions.

The Hebrew University of Jerusalem (HUI) is a major research university located in a Western industrialized country. The university has created an independent wholly owned subsidiary, called Yissum, for the negotiation of contractual arrangements, licensing and patenting and the development of joint ventures in the R&D domain. HUI demonstrates a series of well-defined and university-wide policies in relation to intellectual property rights, conflict of interest and loyalty, as well as open communication of research results. HUI has also developed a number of incentives for staff which show that the university has a clear commitment to the development of university-industry linkages.

The Papua New Guinea University of Technology (PNGUT) is a university with technological orientation located in a small state with a highly dependent economy. As the Hebrew University, it has set up a commercial firm, Unitech Development & Consultancy Pty Ltd (UDC), which offers a wide range of commercial services to the enterprises of the country, such as collaborative R&D, but also many continuous education programmes. However, in comparison with the highly centralized approach used at HUI, the interface of PNGUT, UDC is internally set up in units which are directly controlled by the departments of PNGUT.

Bogaziçi University in Turkey is a comprehensive university with an elitist reputation in Turkey. Again, the university has set up a foundation, called BUVAK, which acts as an external interface. BUVAK has created three different subsidiaries, one of which is called KAMPUS which is

responsible for the commercialization of consultancy and continuous education services. Bogaziçi University demonstrates impressive results in the scope of services offered to enterprises and in the extent of its income-generating activities. University-industry linkages have in the past grown in an organic fashion. However, the university has recently started to develop a general policy in the domain of university-industry linkages.

The University of São Paulo is a major research university located in one of the economically most developed regions of Brazil. The University of São Paulo has a declared mission with respect to the development of university-industry linkages and is in the process of either developing or already revising a number of university-wide rules for the distribution of income and other incentive measures, such as criteria for staff promotions, taking into account staff commitment in the domain of collaborative activities with industry. In terms of organizational development, the university has adopted a rather decentralized approach. A multitude of foundations, mostly at the faculty level, which offer a broad range of services and activities in the domain of university-industry linkages, have been developed.

The Faculty of Technology at the University of Makerere represents another interesting case study. At this faculty, the academic staff has set up a consultancy firm, TECO, which offers technological services and professional training to surrounding enterprises. For the local small and medium-sized enterprises (SMEs) a special project, the Uganda Gatsby Trust (UGT) has been created with foreign seed money, which offers an association of SMEs to the Faculty of Technology, providing them with technical assistance, training opportunities and small loans for enterprise development. The same initiative allows students to join the SME sector for internships to work on specific projects. The example of the Uganda Gatsby Trust demonstrates how a university in a least-

developed country framework can become extremely relevant to local and regional economic development.

Obviously, the research and teaching capacity within the higher education institution, the surrounding industrial base, a tradition of interaction between higher education and enterprises and the prevailing culture (entrepreneurial or not) of the higher education institution condition the type of interaction and the degree of density of relations. Such a context generates different forms of linkages, but it is a conclusion of the case study research that the context does not condition the very existence of such linkages, but more their particular nature.

2. Prevailing types of linkages

The five following case studies on the management of relations with industry confirm the hypothesis that relations with industry have developed considerably over the past decade in all analyzed institutions. If such relations have developed in number, it is also fair to say that their scope is widening, in the five case institutions, to embrace new types of linkages and modalities for their implementation. As a consequence, traditional types of linkages tend to coexist with more recent ones. With regard to a traditional type of linkage, placement schemes for student internships are still a predominant mechanism.

More recent types of linkages have been developing in the field of continuous professional development and consultancies. Within a context of resource constraints, universities tend to market those products where they have a comparative advantage over other providers.

A further, most recent and increasingly important type of linkage is enterprise development. Many higher education institutions and nearly

all case institutions have developed special structures such as incubators or innovation centres, or specific programmes of enterprise development, such as the Uganda Gatsby Trust, at the Faculty of Technology of Makerere University. Enterprise development can be geared either to the development of existing SMEs or to the creation of start-up firms, usually set up by an academic staff member or a graduate student to commercialize a university invention. Start-up firms are usually logistically supported by so-called business incubators or innovation centres, which may be an interface structure managed by the university or in which the university plays an important role. Playing a more active part in the domain of enterprise development makes the university an increasingly important partner in local economic development.

3. Strategic management of university-industry linkages

The five case examples demonstrate that as the relations of higher education institutions with enterprises are developing, they become more complex and also more difficult to manage. Management of these relations refers to both strategic and operational management issues. Strategic management of university-industry relations implies that the development of university-industry relations is established as an explicit university-wide, medium and long-term objective and part of the overall university mission. Since the development of such relations has traditionally been a matter for individuals and departments, it is only more recently that the central administration is trying to co-ordinate, guide and support initiatives which are naturally of a bottom-up nature. The case studies demonstrate that, however dynamic institutions are, only few of them have a written statement of policy for the development of their relations with industry. Policies for the development of university-industry linkages are surely in place, but they are more implicit and perhaps more responsive than proactive in nature.

4. The management of interfaces

All five case studies have demonstrated that the creation of interfaces, be they internal or external, is a common feature of developing university-industry relations. The above discussion of the case studies demonstrates a number of trends, of which the first one is an increasing diversification and specialization of interfaces. This is not very surprising, given the fact that the objectives of these relations have become more diverse. If the initial objective has been the fostering of knowledge transfer from higher education institutions to industry, the income-generation purpose now stands much more in the forefront and drives relations with industry forward in more diverse forms. The case studies have also shown that relations with industry are in fact a dynamic process reflected in the diversification of organizational structures, at the institutional level. If institutions often start with the setting up of an industrial liaison office, they then, over time, put into place external interfaces such as foundations or consultancy centres.

Specialization of interface functions is taking place in a context where such interfaces are granted increasing autonomy in order to bypass internal rigidities such as administrative rules and the existing organizational structures along departmental lines. Administratively autonomous interfaces can then contract personnel with the particular skills needed, in particular in the technology management area, purchase necessary equipment and materials, organize interdisciplinary teams, negotiate contractual arrangements, etc. The particular challenge, however, for the mother institution is the control of these structures with the aim of making sure that they all contribute to the overall institutional mission and policy. Most institutions have developed effective mechanisms, both formal and informal. Formal mechanisms are rules and regulations that stipulate the level of autonomy of the interfaces, whereas informal mechanisms try to place high-level

university managers in their governing boards, sometimes also at the top executive level of the interface.

The interfaces discussed in the case studies distinguish themselves to a great extent by the level of their centralization. The issue of centralization is very much linked with the question of control and how communication is assured with the basic units of the alma mater. Only three of the five case institutions have university-wide interfaces, i.e. Yisum of the Hebrew University, BUVAK of Bogaziçi University, and UDC of the Papua New Guinea University of Technology. The other two institutions have set up interfaces at the faculty or the departmental levels such as the foundations at the University of São Paulo or TECO of the Faculty of Technology of Makerere University.

With regard to their internal structuring, several of the interfaces indeed reproduce the departmental structure of their mother institutions or faculty (i.e. UDC of Papua New Guinea Technological University or TECO of the Faculty of Technology at Makerere University). This demonstrates that interfaces are set up in such a way that basic units (i.e. departments) can have direct control over their subsidiaries. Such an organizational structure ensures a direct communication between the basic unit and its subsidiary and strengthens the ownership of departments over it. A decentralized affiliation of an interface does not, however, facilitate the implementation of university-wide policies and rules, or the development of interdisciplinarity or cross-departmental collaboration with industry and business.

5. Financial management of university-industry linkages

Beyond the issues of strategic management and organizational development in university-industry relations, this case study research has also been exploring innovative methods in the operational management of such relations. With regard to financial management, it

could be demonstrated that the income-generation impact may be considerable. At the University of Bogaziçi, income-generating activities of a diverse nature represent about 14 per cent of the total university budget and exceed the contribution from tuition fees. As a consequence, Bogaziçi is one of the institutions that have succeeded in establishing a diversified income basket and in creating real margins of autonomy.

Within this context, higher education institutions are currently designing appropriate instruments for the costing and pricing of products, rules for the determination of appropriate overhead provisions and the distribution of generated income. One of them, the Hebrew University of Jerusalem, has been developing instruments such as risk capital to finance high-risk joint ventures with enterprises to commercialize university inventions. With regard to costing and pricing, case universities mention that their price setting is usually guided by a full-cost approach, and not by a price that the market will bear. Institutions generally charge a flat overhead rate for the use of equipment and central services (for instance 35 per cent at the Hebrew University of Jerusalem).

With regard to the issue of distribution of income generated from collaboration with the productive sector, the case studies have brought to light that institutions are adopting very different practices that reflect various underlying conceptions related to the work with industry. Those who consider that such activities are part of the mainstream mission, foresee a rather small percentage of the generated income for the individual who has performed the job. Most case institutions, however, assume that work with industry is not part of the mainstream activities. As a consequence, individuals need to receive a specific remuneration for such work. They give preference to a distribution of generated income that acts as a financial incentive to individuals or teams of researchers.

6. Staff management in university-industry linkages

The distribution of generated income is an issue that is tightly related to the discussion of personnel policy. In the case study research, questions were posed with regard to staffing and staff development, incentives, the protection of the right to publish and, finally, codes and ethics for the collaboration with the private sector. The question of staffing and staff development is of course of crucial importance, since the strengthening of relations with industry depends in the first place on the competences and skills of the staff involved and the building of understanding and awareness among all personnel, both academic and support staff. Very few universities worldwide have conducted audits to determine the precise competences needed and to offer appropriate training schemes. With a view to developing relations with industry, staff recruitment and development are hardly ever based on a needs analysis, but they are generally done in an ad hoc manner, if at all. The University of São Paulo is the only case institution that offers in-house training programmes for the development of managers of interface structures. The more common strategy is to recruit new staff, for instance for the liaison office, with the appropriate competences, such as working experience in industry and a good knowledge of R&D work in the university. More specialized competences and knowledge such as those related to the management of intellectual property, are often subcontracted by the case institutions, if such competences are at all relevant.

However, appropriate staffing and staff development are not enough to motivate university personnel to engage in university-industry relations. Financial or material incentives are necessary to signal to staff that the institution values their involvement with the private sector. All case institutions have put into place a series of incentives, some of which recognize collaborative work for decisions

over promotions. If personnel statutes make the change of promotion criteria difficult, institutions try to provide material incentives, such as refurbished office space, or access to travel grants, to motivate staff. In one case institution, the Hebrew University of Jerusalem, a direct supplement to the basic salary has been determined to remunerate staff for their efforts in collaborative projects.

It is, without doubt, essential to encourage staff to collaborate and to develop new paths for collaboration with the productive sector, preferably, but not exclusively, through established procedures such as new promotion criteria, salary supplements and other material incentives. However, it is also important to make sure that traditional activities, in particular teaching obligations, are not neglected. Some universities do not allow their staff to commit themselves to any outside activities that are not managed by the university. This is, however, somewhat regrettable, given the fact that, for instance, consultancies linked to the speciality of the university staff are an occasion for professional enrichment, which is important to update teaching. Most universities, among which the Hebrew University of Jerusalem and the University of São Paulo, accept that a staff member spends one day a week with outside activities, but they expect the staff to inform their supervisors of such activities. Other universities have not established any rules and they implicitly expect university staff to adopt their own code of ethics. In contexts where university staff have difficulties in making a living on their salary, such a personal code of ethics might not be sufficient, since the natural trend will be to seek outside employment. It then becomes a matter of survival for an institution to offer in-house opportunities for supplementing salaries, as well as to establish university-wide rules and guidelines for the use of staff time for outside consultancies.

Finally, a personnel policy geared towards the development of

relations with industry, needs to preserve a university staff member's right to publish within given limits of time. This issue embodies the inherent conflict of industry, being concerned with the best protection of intellectual property as well as a university staff member's desire to publish in order to establish and maintain a professional reputation in a given speciality.

Those universities that have developed policies in the domain of intellectual property protection, have also usually addressed this issue. They have established rules regarding the maximum lapse of time during which publications may be withheld, generally for some months at a maximum. In order to protect university staff and the university as an institution, it is important that such rules are negotiable only at the margin.

7. Management of intellectual property rights (IPR)

A last issue addressed in the case study research is the management of intellectual property. All five case institutions acknowledge the potential importance of this issue, and they indicate that it is high on the political agenda. However, only two are active in this domain. This is at least partially due to the fact that there is not very much collaborative R&D between the university and the productive sector. Another reason is the weak legislative framework and the lack of tradition for the protection of patentable R&D, such as mentioned by the Papua New Guinea University of Technology. And finally, it is often difficult for universities to bring inventions up to a stage where they could be filed for a patent, given the fact that this often needs considerable supplementary investment and expertise. It is only when universities can expect an important benefit from the commercialization of IPR through royalties and licences that they set up appropriate policies, structures and procedures in this domain. The Hebrew University of Jerusalem is

particularly active in this domain. Through its subsidiary Yissum, considerable income is generated from IPR. Yissum has reserved itself exclusive rights in this domain and centrally manages all issues, including: the negotiation with industrial partners of the terms of IPR, setting up of joint ventures for the financing of further development to bring inventions to a patentable stage, the filing of patents and their commercialization. However, most other case institutions involved in collaborative R&D either leave IPR with the individual staff who were responsible for the R&D project, share IPR with the collaborating industry, or leave it entirely to the industrial partner.

8. Conclusions

As a final conclusion, it can be said that successful management of university-industry relations should be based in a strategic management approach that makes the development of such relations a declared university-wide, long-term development objective. Strategic management of university-industry relations is necessary also to avoid universities seeking primarily immediate profit and compromising their longer-term vision, in particular in a context of financial stringency from the public budget.

Strategic management of university-industry relations should also be concerned with the development of appropriate support structures for the implementation of such a strategy. As a consequence, strategic management of university-industry relations needs to be concerned also with the co-ordination of such structures through a central authority which reports to the highest executive level in the university, the head of institution or governing body. Without central management, newly established structures or activities are in danger of being sidelined by a longer-established department of the university. Also, strategic management can ensure that there is a synergy and natural affinity of

purpose between traditional and newly established units of the university.

A policy concerned with the development of university-industry linkages needs to be backed up by top management which supports initiatives emanating from the departments. It is also important to set up appropriate decision-making structures that translate political will into operational capacity. Many institutions have created a high-level post, such as a Pro-Vice-Chancellor in charge of extension services, who acts as a symbol and leader in this respect. The opening up of traditional governance structures, such as the university council, to representatives from the productive sector may also mark a similar political will and create opportunities for collaboration.

However, it is also extremely important to put in place an operational management capacity through the creation of well-staffed support structures, i.e. internal or external interfaces, tightly controlled by the alma mater but endowed with the necessary flexibility to react quickly to market opportunities. Where there are several or even numerous interfaces, it is important to co-ordinate activities, design university-wide rules and create synergies. This is not always easy, given the generally decentralized nature of universities. However, the appropriate balance between centralization and decentralization, as well as autonomy linked with checks and balances, can be considered as critical success factors in the development of university-industry relations.

**YISSUM, THE INTERFACE FOR UNIVERSITY-INDUSTRY
PARTNERSHIPS AT THE HEBREW UNIVERSITY OF
JERUSALEM, ISRAEL**

by

Moshe Vigdor

*"... Our highest ideal must be
the acquisition and diffusion of
knowledge. Only then can we create
those permanent conditions in
which practical achievements can
also flourish and bring benefits to
the country."*

Albert Einstein

'Foreword' to The Hebrew University of Jerusalem
1925-1950

THE MANAGEMENT OF UNIVERSITY-INDUSTRY RELATIONS AT THE HEBREW UNIVERSITY OF JERUSALEM, ISRAEL

1. Socio-economic background

Industry in Israel has developed rapidly during the past 50 years since the establishment of the State of Israel.

One of the most dominant phenomena relating to the development of high-tech and science-based industry during the last two decades is the rapid expansion of ties between academic research and industry.

High-tech and science-based industries were formed, in many cases, at a university laboratory and others were initiated by inventors and researchers from academic institutions. The establishment of Israeli high-tech and science-based industry is strongly linked to the broad scientific infrastructure that was developed at the local universities and research centres, with heavy support from the State of Israel.

More than three decades ago it became clear that only a heavy investment in scientific research would enable the development of a well-advanced high-tech industry. Economic indications were that Israel should have a relative advantage in developing high-tech industry based on scientific excellence and the high level of its skills and technological education. The development of high-tech industry and a wide scientific infrastructure became a strategic goal.

In various places around the globe it has been demonstrated that the relative industrial production growth in recent years is closely linked with the new high-tech start-up companies. These companies are characterized by rapid growth and development. A similar trend took place in Israel during the past two decades, when many new start-up

companies were formed. Israel is now the second economy in the world after the USA in the number of start-ups per capita.

There were three main engines that helped to accelerate the development of the Israeli economy during the first half of the 1990s. The first one was the wave of mass immigration from the former Soviet Union. These immigrants were highly skilled people, with know-how and motivation. The second was the peace process that brought a wave of investments to Israeli industry. The third engine was the high-tech revolution. Israel had developed an impressive technological ability in defence industries and in its research centres. Excellent engineers and scientists from the defence industries left the established industries and formed hundreds of start-up companies in the fields of computers, software, lasers, micro-electronics, telecommunications and biotechnology.

The above three phenomena were closely linked: highly skilled engineers and technicians who immigrated to Israel were absorbed in the new start-up companies that were being formed by the engineers and scientists from the well-established defence industries. These industries were shrinking due to the reduction in the needs of new military developments and due to the cuts in military budgets.

At the same time, multinational companies invested hundreds of millions of dollars in Israel's industry and accelerated the process of raising monies on Wall Street to invest in Israel's industries and start-up companies. Israel became the second foreign country (after Canada) in the amount of monies raised for its industries on the New York Stock Exchange.

The revolution of Israeli industry continues today where the traditional industries of food, wood, textiles, and plastics are being replaced by high-tech and science-based industries.

The leading industries in Israel at present are in the areas of pharmaceuticals, chemistry, computers, telecommunications, electronics, biotechnology, medical apparatus, etc. More than one thousand new start-up companies are active and develop new high-tech products.

Ownership of industry in Israel is mixed. In the past, most of the leading industries were owned by the government, by Israeli unions, and by banks; the trend now is to privatize. Leading industries are nowadays owned by the private sector and their shares are traded on the Stock Exchange. The process has not yet been completed and activity is still under way to privatize industries. Start-up high-tech companies are characterized by private ownership.

There are several industrial enterprises in Israel with more than 5,000 employees. Most enterprises, mainly those that produce high-tech products, have a few hundred employees and may reach the level of 2,000 employees. Start-up companies, software and the like, have up to one hundred or two hundred employees but income per capita is very high. For some economic developments and forecasts, see *Appendix A*.

2. The Hebrew University of Jerusalem

The Hebrew University of Jerusalem opened in 1925. The university, since its inception, has been strongly involved with the needs of society, and has contributed to its economic, social and cultural development. The mission of the university is to achieve excellence in research and teaching, to contribute to society and to be the cultural and academic centre of the Jewish people.

The seven faculties of the university are: the Faculty of Science; Faculty of Medicine; Faculty of Dental Medicine; Faculty of Agricultural, Food and Environmental Quality Sciences; Faculty of Law; Faculty of Social Sciences; and the Faculty of Humanities. Schools at the university

are: School of Education; School of Social Work; School of Applied Sciences; School of Pharmacy; and many others.

The total budget of the Hebrew University is US\$400 million (1998). There are 24,000 students, 1,200 employees on the academic staff (about half of them are professors in the experimental faculties, active in research), 1,500 additional employees working in research, 2,000 administrative employees (altogether 4,700 employees). The number of research projects totals about 2,000, the research budget is US\$68 million (1998) and income from industry for research is US\$10 million, i.e. 2.5 per cent of the total budget. The university is located on four campuses (Mount Scopus, Givat Ram, Ein Kerem, and Rehovot).

3. Development of university-industry relations at HUJ

The university-industry relations at the Hebrew University were developed mainly during the past three decades. Relations between industry and university researchers became closer when both parties realized the potential benefits from co-operation. Relations developed also when university researchers were faced with the fact that it was becoming harder to obtain competitive research grants from various agencies and when industry became a legitimate source for research grants.

At the same time, it was recognized that the quality of the research conducted at the industry by the industry's researchers was of good standard and that the industry's researchers and scientists were potentially equal partners to the university scientists involved in applied research.

Therefore the main parameters that fostered the development of university-industry relations at the Hebrew University were the search for more research grants by university researchers and the improvement of quality of research and scientific work within industry itself.

At a time when research grants were easy to obtain, few researchers were interested in contacts with industry. When it became more difficult to secure research grants, when industrial research and development activities began to receive recognition and when more managers in industry were past students of current university professors, contacts started to develop rapidly.

3.1 Creation of an external interface for the commercialization of R&D: Yissum

The Hebrew University established a wholly owned subsidiary called 'Yissum Research Development Company of the Hebrew University of Jerusalem'. 'Yissum' is the Hebrew word for 'application'. The aim of this subsidiary was defined in University Administrative Regulation No. 15-001 (*Appendix B*).

'Yissum' was established by the Hebrew University in 1964. The main objective of the university in establishing this company was to create an effective independent vehicle that would foster and promote university-industry co-operation and relations. The idea was to set up a business-like tool that would develop capabilities in the areas of marketing, negotiations, licensing, contracting etc. During the years since its establishment, 'Yissum' has become a business company with strong abilities in the areas of patenting, intellectual property, licensing, negotiation, and entrepreneurship. Yissum today is a leading firm in Israel, well known worldwide as a business arm of the university which conducts and fosters co-operation with industry and with investors, including in venture capital funds.

This enterprise, which is a commercial company operating for profit, became the main mechanism to enhance co-operation between the university and industry. This company turned out to be a major intermediary between research projects and industries needing them.

Yisum acted as a bridge for contacts between university researchers and industry's managers and research and development directors.

Yisum deals with inventions produced by Hebrew University research and registers patents and their utilization. Yisum represents the Hebrew University in all matters relating to commercial and industrial utilization of the results of the research conducted therein.

Yisum is empowered by the university, inter alia, to determine whether the university has rights in an invention of an employee; to decide whether to seek protection for the invention, including prosecuting in the name of the university with the approval of the management of the university; to define the lines of action and the type of engagement regarding the commercial and industrial utilization of the patents and inventions, and to negotiate with commercial and industrial institutions or bodies and enter into any agreement in connection therewith; to manage and organize the rendering of services on a commercial basis; to manage the commercial and industrial production and utilization of patents and inventions carried out within the university, for it or in connection with it; to define the rules regarding secrecy, including the conditioning of its action for the protection and the commercialization of the patents and inventions by restricting the publication of the inventions.

The attitude of the academic community towards Yisum has changed over the years. It was found that as Yisum became more professional and more business oriented, the academic community had more respect for it and accepted its role. Yisum works very closely with the researcher and works very intensively to gain his/her faith and confidence.

For the academic community, Yisum is a service-agency to foster business co-operation with industry. When the service rendered is in all respects of a high standard, including the ability to develop relations

with leading industries, the academic community is more likely to fully accept such an interface. If it does not retain high standards of professionalism, the academic community will most likely criticize its role and bypass it entirely.

3.2 Governance and organizational structure of Yissum

The Company Yissum is headed by a Board of Directors nominated by the President of the Hebrew University. The Board is comprised of members from the business community and from the academic community (five members each) and headed by a chairperson nominated by the President of the Hebrew University from the business community and who is a member of the Board of Governors of the university.

The General Manager of Yissum is elected from time to time by the Board of Directors and he/she reports to the Board.

The staff of Yissum is comprised of a total of 12 employees including secretaries, accountants, marketing manager, contracts manager, operations manager, and patenting expert. All employees are employees of Yissum and not employees of the university.

The company uses the services of a law firm and some other services, such as patents attorney, computer consultants, etc.

The chairperson of the Board of Directors of Yissum reports periodically to the General Council of the company, at its shareholders' meeting, i.e. at the university. Periodical reports are provided to the management of the university by the company's Board. Neither the management of the university nor any university officer may intervene in Yissum's activities, discussions and business process or corporate policy.

The organizational structure of Yissum is shown in *Appendix C*.

3.3 Relations between Yisum and the HUI

As a company, Yisum retains full autonomy in accordance with the university management regulations relating to Yisum and to relations of university-industry in general and under the agency agreement signed between the university and Yisum, which defined the services that Yisum is entitled to render to the university.

Once the long-term agency agreement between Yisum and the university was signed, and once the management regulations of the university were defined, Yisum was fully autonomous and authorized to conduct contacts between university and industry on the optimal level and expected to generate income and to show profits.

The Hebrew University has established another administrative body to foster and to manage its research and scientific development activities, the 'Authority for Research and Development'. The Authority is responsible for the negotiation, budgeting and administration of all research grants and contracts where the area of industrial funding is managed by Yisum. The Authority searches for and investigates potential funding sources, initiates new contacts with potential funding sources and agencies in Israel and abroad, circulating information on all funding sources among university researchers, and matching researchers with appropriate granting sources to ensure that promising projects find funding. The Authority encourages international co-operation, which is critically important in further development of university research and in attracting funding from abroad and co-ordinating international exchange programmes.

Measures have been taken to avoid conflict of interest between Yisum and the Authority for Research and Development and to assure full co-operation. The definition is clear: Yisum is active among industries and is engaged with business associates; the Authority is engaged only with non-profit organizations, with governmental agencies and with funds for the university's research, with no strings

attached. The Authority will never accept research grants which include commercial aspects unless in collaboration with Yisum. The Head of the Authority is the University Vice-President for Research and Development, who is also a member of the Board of Directors of Yisum. This ensures full co-ordination and clever segmentation in the process of searching for funds for research from a variety of funding sources.

When Yisum signs a contract with a commercial organization, it usually collects a 35 per cent overhead, of which 20 per cent is transferred to the university via the Authority. In the case of income generated from royalties, a third will be transferred to the Authority to open a general research account to be used by the researcher. Yisum's annual net profits are transferred to the Authority for Research and Development for the purpose of funding new applied research proposals submitted to the Authority by Hebrew University staff and which have been recommended for funding by external referees. The Authority, in conjunction with Yisum, is funding interesting applied projects with a commercial potential from an internal venture capital fund that was recently established by the university. This fund enables the research project to be brought to an advanced stage so it can more easily be transferred to industry.

3.4 Staff management issues

The researchers of the Hebrew University are the employees of the university and not of Yisum. When Yisum uses their services, they are paid a consultancy fee by Yisum.

As a policy, Yisum will not hire any researchers to be its employees. All personnel for a specific co-operative project between university and industry will be hired by the university and all research work will be done in the university, while Yisum will ensure that the budget is provided as defined in the agreement between Yisum and the industrial party.

Yisum has developed an incentive scheme for university researchers who work with industry on a specific project. The researcher will receive from Yisum a consultancy fee, as mentioned above, or a special payment under the category of 'project management fees'. The basic salary of the researchers is always paid by the university as they are university employees.

A financial tool has been developed at the Hebrew University to motivate staff to collaborate in projects with industry and to obtain external research grants from various sources in general. This tool is an agreed scale which enables the university to calculate automatically an addition to the researcher's salary, which takes into account the size of the extra-budgetary funds attracted by the researcher and the type of the enterprise. When a contract is signed with a 'for-profit' organization (for example an industrial enterprise), the researcher can expect to get up to 50 per cent addition to his salary (assuming the project is 'big'), even if he is involved only with one such contract. If he attracts more extramural funds, he may expect to get a higher addition to his salary, up to a maximum of 90 per cent.

The addition to the researcher's salary is calculated more precisely in the following way:

There are three types of research funding sources: those which are coming from the current university budget or other university-related sources, which will be defined as 'Type 0'; sources which are related to 'non-profit' organizations, including governmental agencies or ministries, which will be defined as 'Type B'; and sources which are related to 'for-profit' organizations, including industries and many research funds from abroad, which will be defined as 'Type A'.

When a university academic staff member obtains a research grant of 'Type 0', he or she will not receive any additional salary for that.

If the staff member obtains a research grant of 'Type B', he or she will be entitled to a salary addition on the following scale:

Less than US\$6,000	=	nothing
US\$6,000 to US\$12,000	=	an additional 6 per cent
US\$13,000 - US\$20,000	=	an additional 12 per cent
US\$21,000 - US\$45,000	=	an additional 20 per cent
Over US\$45,000	=	an additional 25 per cent.

In the case of 'Type A' grants, the following salary additions will be applied:

Less than US\$6,000	=	nothing
US\$6,000 - US\$48,000	=	an additional 30 per cent
US\$49,000 - US\$75,000	=	an additional 40 per cent
Over US\$75,000	=	an additional 50 per cent.

When a researcher obtains more than one extramural grant, a formula is used to calculate the size of the salary addition, which is a little more complicated. It is not a simple mathematical calculation of the separate additions related to each individual grant the staff member has obtained, but it is definitely a significant sum. However, the maximum addition that a staff member can expect to receive is not more than 90 per cent to his salary (when the staff member obtains many research grants) and not more than 50 per cent when the staff member obtains one single extramural grant.

Since industries are always 'for profit' organizations, their grants will entitle the staff member to a higher addition (Type A). A scientist who obtains several industrial grants can thus quite easily almost double his or her salary. There are rarely cases of dissatisfaction or misuse of the formula.

The Hebrew University has developed an incentive programme relating to Yisum employees. Such employees (who are not university employees) will receive a special bonus for achieving good business results and for expanding the financial volume with industry. This is being handled by Yisum's Board of Directors.

Yisum has to ensure that the agreements it signs with business concerns safeguard the researcher's right to publish to the maximum extent possible. Master's and doctoral students whose research was carried out under an agreement with a business concern retain the right to submit theses and doctorates for evaluation and approval as they see fit and in accordance with the accepted procedures of the Hebrew University.

The publication of a research study that was financed or is being financed by a business concern, or the transfer of any know-how whatsoever relating to this research, including information on the very existence of the research, is done with prior co-ordination with Yisum, and as required by the agreement between Yisum and the business concern financing the research. Under the agreement, Yisum can allow the concern financing the research work to clarify its position within 45 days of the date when notification was sent it of the intention to publish the research study that it financed in the scientific press.

Any opposition on the part of the business concern financing the research to the publication of the research in the scientific press is accepted if it can be proved, to Yisum's satisfaction, and with the approval of the Rector of the university, that such publication could prejudice the business concern's rights and damage its interests.

Notwithstanding the above, a business concern cannot delay publication in the scientific press of the results of a research project financed by it for more than six months. During this delay, the business concern financing the research may adopt requisite measures to

safeguard the research results, including filing for a patent. Yissum is entitled to grant the business concern's request to delay publication in the scientific press for a further period of up to six months if, in the explicit opinion of Yissum's patent adviser, the research results do not yet constitute the basis for a valid patent. The executive committee of the Research and Development Authority may approve a further delay in publication, upon presentation of a well-supported request by Yissum, if it can be demonstrated that publication in the scientific press of the results of the research financed by the business concerned will cause direct financial loss to the concern.

The right to prevent publication of the results of research work for reasons of national security is reserved exclusively to the President of the university and the Rector, after they have weighed the arguments raised against the scientific publication of the research study for security reasons and have so decided.

As can be seen from the publication issue, Yissum acts here as an independent agent committed to the contract between industry and the university and committed to the project and its success.

This is a very clear case when Yissum has to mediate between the needs of the researcher to publish and the concerns of the industry about such publication.

3.5 Financial management issues

The total turnover of Yissum for 1998 was US\$14 million. All income is collected from industry as the result of university-industry co-operation.

Yissum's operational costs	:	US\$0.8 millions
Secured for research budgets	:	US\$9.7 millions
Income from royalties	:	US\$3.5 millions
<i>Total</i>	:	US\$14.0 millions

The total turnover has increased from US\$10 million five years ago to US\$14 million and is expected to reach US\$20 million within five years, mainly because of the rapid increase in income from royalties.

As a matter of policy, the university does not provide any financing to Yisum. Yisum should be self-supporting and is expected to transfer research funds to the university in general and to the Authority of Research and Development, in particular. Approximately US\$9 million were transferred from Yisum to the university in 1998 as follows:

For research projects	:	US\$6.3 million
For overhead	:	US\$1.5 million
From royalties collected	:	US\$1.2 million
<i>Total</i>	:	US\$9.0 million

It is expected that within five years Yisum will transfer to the university an annual sum of US\$15 million.

Royalties are being distributed as follows: 33 per cent to the researcher/inventor privately as a direct incentive; 33 per cent to research at the university; 33 per cent to the university via Yisum for general budgetary use. The rationale for such distribution is to provide incentive to the researcher-inventor and to repay the university and Yisum for their part in the endeavour. This formula also allows the creation of a financial margin for the stimulation of future promising applied research projects.

The annual expenses of Yisum, which administers all the activities which generate the above income, are about US\$800,000, including costs for new patent registration fees.

It is important to note that Yisum charges the industry, for any research contract, an overhead of 35 per cent above the budget presented by the researcher and needed for the conducting of the

contractual research. The 35 per cent overhead is used as follows: 7.5 per cent to Yissum to cover its general costs; 20 per cent to the university where the research will be conducted; 7.5 per cent to the department where the research will be conducted to cover general costs, to buy new equipment and for repairs. The figure of 35 per cent was determined as a compromise between the real costs to the university and the ability of industry to pay these costs.

Lately the university has established, together with Yissum, a venture capital fund to encourage more new applied projects within the university research framework. The US\$5 million fund is aimed at bringing general ideas developed by university researchers to a more advanced stage where Yissum would be able to offer industry a more advanced technology and thus to commercialize it on better terms.

The university researchers approach Yissum and provide a research plan describing background, commercial potential and budget needs (see Appendix D) and Yissum analyzes the potential and provides financial support to those projects with the highest potential of attracting industry.

Over the years, Yissum has developed financial tools and funds to support a research project directly or to attract industry in a joint investment.

3.6 Modes of operation of Yissum

The following are the most current modes of operation of Yissum:

- research and licensing agreements between Yissum and the industrial/entrepreneurial party in a project;
- services to industry which are provided by a researcher of the university through Yissum;

- research co-operation to create new know-how and new technology through Yisum;
- consortia to create a new wide generic know-how;
- joint venture between Yisum and industry/entrepreneur/venture capital fund to create a new start-up or a new enterprise based on a specific know-how/project/ patent developed by a researcher or a research group at the university.

The main mode of operation for co-operation between the university and industry are still 'research and licensing agreements' where research results (whether patented or not) are licensed to interested parties in industry. In return, the industry finances continuing research in this field at the university, commits itself to develop products that will be the outcome of the project, and gives a firm commitment to pay the Yisum Company royalties.

In the case of 'services to industry', the industry purchases some research services, mainly analysis, testing, etc. and receives the results for its use where new know-how is not being generated, thus there is no licensing required.

When forming new joint ventures with industry or with entrepreneurs or venture capital funds, Yisum and the partner create a new enterprise, owned by them, and grant exclusive rights to the new joint-venture enterprise to license the research project/invention/patent, developed by the university researchers.

The other party in the joint venture finances the activities of the joint venture, including further research of the said project at the university laboratories. Yisum takes an active role in the routine management of the new joint venture in the early stages and steps back as time passes and as the project develops into a product. At the stage

where the product is produced and sales begin, Yissum will look to sell its shares and to invest the income in a new project, while it continues to receive royalties from net sales.

The university itself is not involved directly in licensing and contracts signed with industry. The university provides research services under a separate and exclusive agreement with Yissum. The university as a legal entity is not involved in business and confines itself to its mission. The relations between university researchers and industry have been developed very carefully.

Yissum has proven to be a most important tool for negotiations, licensing, and collection of royalties. But the most important factor to boost the contacts between university and industry is the creation of the lively and routine dialogue between the researchers themselves and the industry's managers and research and development directors. It is an ongoing and continuous task to sustain the current type of connection which exists between the Hebrew University and industry.

Example: Research and licensing agreement

A new patent was registered on an invention of a slow-release drug for periodontal use. The inventors were three researchers from the university's School of Pharmacy and the Faculty of Dental Medicine. The new invention was filed as a patent by Yissum and was licensed to Israel Chemical Industries Ltd (ICL).

ICL supported further research at the university laboratories, including clinical trials and, in parallel, developed a production line in which the product would be produced under sterile conditions.

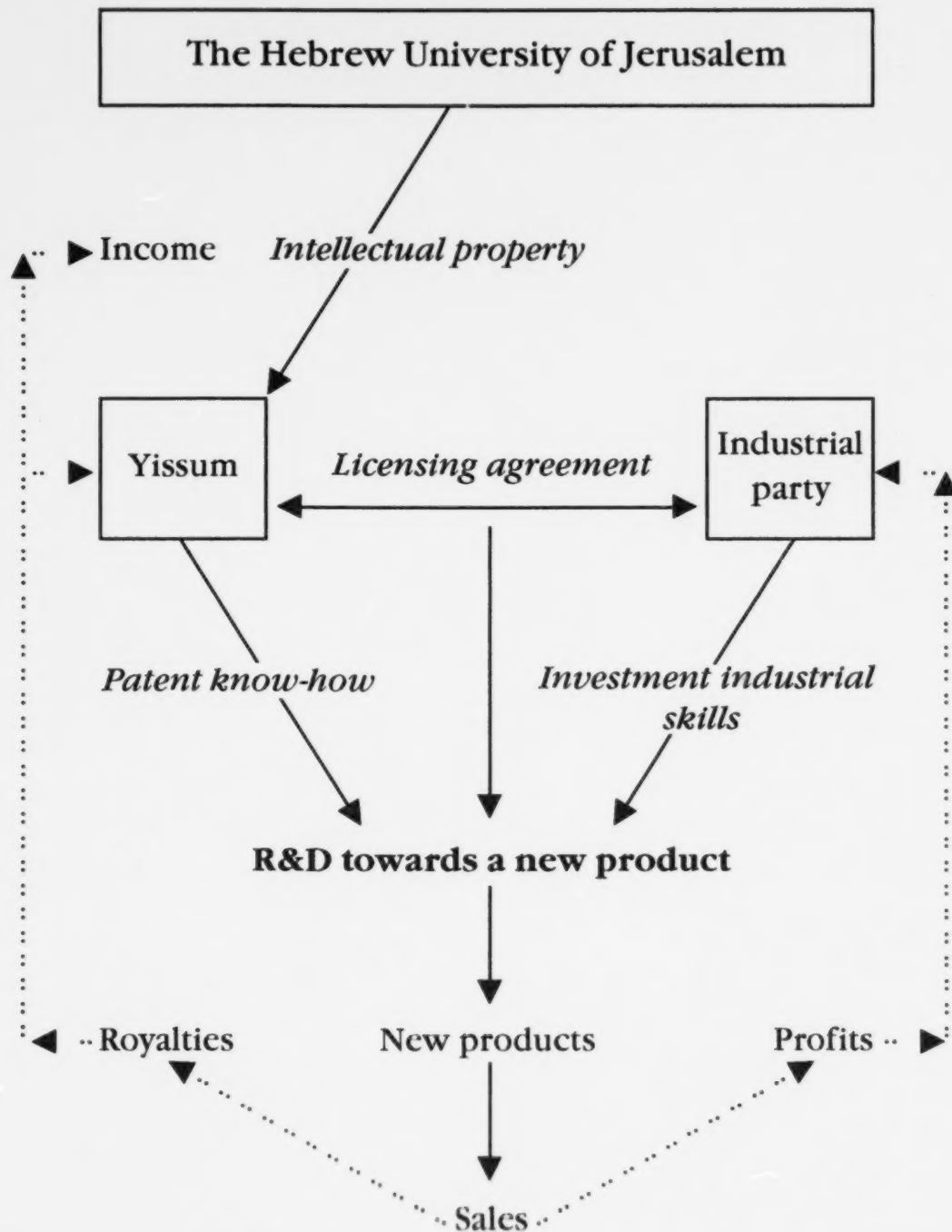
ICL responsibility was also to develop marketing tools and to seek FDA approval and all other permits prerequisite to marketing the product.

Approval was granted and the ICL has formed a new subsidiary called Perio Products Ltd, which is producing this product, marketing it, developing new versions and providing technical services in the market. The total investment of the ICL from the very beginning until completion of the new production and approval by the authorities is estimated to be US\$25 million. The researchers continue to be involved by means of consultation that they provide to Perio Products Ltd.

Yissum will soon collect royalties and, more important, a new high-tech company has been formed in Jerusalem based on the research developed at the Hebrew University that will provide relief to people throughout the world suffering from periodontal problems. The new company will provide jobs for more employees in Jerusalem and will increase the general industrial output and the GNP. The university will benefit from the royalties received. About 33 per cent of the royalties received will be invested back in research at the university.

The above example demonstrates the strength and the importance of generating contacts and contracts between the university and industry.

Figure 1. Flow Chart: Research and Licensing Agreement



4. Institutional policies with regard to university-industry linkages

The Hebrew University has developed over the years a comprehensive and clear institutional policy geared towards the development of university-industry relations. The academic community of the university accepts and adheres to the rules developed by the university towards the collaboration between university and industry.

4.1 Rules regarding secrecy of generated R&D results

The Hebrew University has developed a set of regulations relating to the nature of relations between its employees, including professors, business enterprises, and industries.

These regulations provide sufficient confidence in the case of the Hebrew University, but may not be found appropriate in some other countries. Thus the regulations may have to be altered when adopted elsewhere.

The rationale behind these regulations is: to control any conflict of interest for the researcher (the university professor) or to avoid such in the first place and to encourage relations with industry, laying out the rules.

The Yisum Company is responsible for establishing contractual relations between members of the academic staff and commercial sources of funding that are interested in entering into such agreements in order to have research carried out and/or to obtain knowledge and/or receive scientific research services. Employees of the university are categorically forbidden to conduct research, pass on know-how related to their research at the university, or supply scientific or technical services to a business concern while making use of university facilities other than via Yisum.

The university reserves the right to sue its employees for damages on account of such know-how or services supplied to a business concern other than via Yissum. All those involved in applied research financed by a business concern should sign a confidentiality agreement. Such an agreement includes, *inter alia*, a declaration by the signatory that any specific know-how that was accumulated, or will be accumulated, in the course of the research is the property of the university, and that it is forbidden to make any use whatsoever of it other than via Yissum, unless prior written consent has been received from the relevant authorities of the university.

Negotiations between a member of the academic staff and a business, aimed at submitting a research proposal and entering into contractual relations to carry out research and/or pass on know-how and/or supply a service in the staff member's field of research, may be conducted only with the approval and participation of Yissum, as specified in the university's Administrative Regulation 15-001 (*see Appendix B*).

The university has decided that only members of the academic staff who are permitted to submit independent research proposals to outside bodies will be authorized to submit research proposals to business concerns.

Research students who are pursuing an advanced degree may be employed in industrial R&D in any framework acceptable to the university, and are allowed to enter into contractual relations for this purpose with business concerns via Yissum, on condition that the proposed research meets the academic criteria required for the conferral of an advanced degree, as determined in conjunction with the committee on research students and on condition that the contractual relations, including the submission of the research proposal, are implemented by or with the participation of the student's research adviser.

Yisum is responsible for determining (by means of the researcher) whether there are any disqualifying and/or restrictive conditions arising from previous agreements and/or contractual relations that provided funding for the project before it was submitted as a research proposal to a business concern.

Yisum is entitled, at its own discretion, to veto relations with a business concern on the basis of the review specified. The researcher submitting the proposal may appeal against Yisum's decision to the executive committee of the Research and Development Authority of the university.

The university regularly checks these rules to ensure that any needed changes are made. This is important, as the university is interested in encouraging contacts with both industries and business enterprises, although in a well-controlled and balanced system.

4.2 Rules to avoid conflict of interest and commitment

The university does not permit a university employee to have an employee-employer relationship with the business concern that is financing his research at the university or its representative or agents.

Where an agreement has been concluded between Yisum and a business concern, the research work of the member of the academic staff under such an agreement shall be carried out in full at the university, unless Yisum agrees otherwise.

A member of the academic staff may advise a business concern in the field and on the subject of the research being financed by the concern only inasmuch as this has been specifically stated in the agreement signed with the business concern funding the research, via Yisum. Details of the consultancy agreement between the researcher and the business concern must be approved by the executive committee

of Yissum. Unless this is explicitly permitted by the said agreement, a member of the academic staff may not advise the company financing the research. The consultancy agreement between the researcher and the business concern shall constitute an appendix to the agreement signed between the business concern and Yissum.

Ongoing activities within the university by industrial staff and/or employees and/or agents of a business concern shall not be permitted, except in special cases and with the specific approval of the Director-General of the university, and upon the recommendation of the Vice-President for Research and Development, the Dean of the relevant faculty and the Head of the department and/or institute.

Yissum may grant a business concern the right of first refusal to apply the results of research conducted under an agreement between it and Yissum. A reasonable time for exercising this right of first refusal is defined as 60 days. Notwithstanding the above, Yissum is entitled to grant a longer period as warranted. If within this period no answer has been received from the business concern granted the right of first refusal, Yissum is entitled to submit the proposal to another concern. In any case, the right of first refusal shall refer specifically to the financing of the research proposal, the application of its results, and the commercial exploitation of a patent.

Rights of refusal shall not be granted for the exploitation of the entire scientific work of a member of the academic staff, the work and research of a research team, or a broad and general field. As a general rule, the right of refusal shall be granted only with respect to the application of research in as restricted and narrowly defined a field as possible.

Consultation services provided by a member of the academic staff to a business concern are a personal matter and impose no responsibility on the university and/or any of its agencies. They must be implemented

in accordance with the university's standard procedures for consultation services, and their scope must not exceed one day per week (Administrative Regulation 05-005). As part of such consultation, a member of the academic staff may pass on general know-how relating to his academic-professional expertise to the business concern he/she is advising, but may not pass on specific know-how that is the direct or indirect result of research that was carried out at the university and which is the university's property.

The researcher may be requested to report from time to time to the Vice-President for Research and Development on the nature of his work as a consultant, giving details thereof, including the scope of his employment as a consultant. A member of the academic staff may not work as a consultant more than one day per week. A consultancy agreement in a field and/or on a topic connected to research being carried out at the university by the consultant for the business concern must be made through and with the approval of Yisum.

As a general rule, the university does not encourage members of the academic staff to hold active executive positions in business concerns and does not view such activity in a favourable light.

A member of the academic staff who wishes to serve in an executive capacity such as president, scientific director, etc., must receive prior approval (at the recommendation of the dean of the relevant faculty) from the executive committee of the R&D Authority, or from a body authorized to do so by the executive committee of the R&D Authority. Such approval may be granted only based on certain criteria that were set for such purpose.

Notwithstanding the above, prior approval is not required when the company in question is owned by the staff member and has no other employees, provided that his activity in such a company does not exceed one workday per week.

Any contractual relations for funding research at the university, and/or for ordering services, and/or for acquiring know-how etc., with a business concern in which a member of the academic staff, including a member of the academic staff on unpaid leave, acts as an executive officer, require prior approval from the executive committee of the R&D Authority, which shall approve the contractual relations after ascertaining that they will not lead to a conflict of interest.

Any contractual relations for funding research at the university, and/or for ordering services, and/or for acquiring know-how and the like with a business concern in which a member of the academic staff, including a member of the academic staff on unpaid leave, directly or indirectly (including through relatives, agents, or other representatives, employees subordinate to him, etc.) holds more than 10 per cent of the shares, requires prior approval from the President of the university. The above applies even where a number of members of the academic staff together hold, directly or indirectly, more than 10 per cent of the shares of the business concern.

5. Supplementary tools to foster relations with industry

In order to expand the number of projects offered by the university to industry, the university has established a special fund to support applied research projects with commercial potential. The university has also established an annual prestigious prize for achievements in the field of applied projects in order to encourage researchers to work also in applied research.

The university also conducts open-day and technological fairs so that people from industry can come to visit and see for themselves. This leads to the creation of contacts, which, in turn, leads to contracts for co-operation.

The university has been involved also in the creation of research parks and scientific incubators. A new high-tech industrial campus (60 dunams) is under way, to be located at the Givat Ram campus adjacent to the Faculty of Science. This new modern scientific park will offer industry, investors, and entrepreneurs access to the Institute of Computer Sciences, Life Sciences, Physics, Chemistry and laboratories of various sorts.

Those renting space in the new scientific park will have the right to use the university libraries and the Computation Centre of the university. The park will also host incubators for new projects.

The park will be managed and controlled by a joint company established between the Hebrew University (50 per cent) and the Jerusalem Development Authority (50 per cent), which is a local governmental authority.

The university is making available the land and access to the research teams (under university management regulations) while the other party is providing the funding to build the park. The management of this joint company will operate the scientific park and will be responsible for marketing the park and providing adequate conditions.

6. Conclusions

The issue of university-industry relations is not a simple one and raises several concerns that must be addressed. The most complicated concerns are those relating to publications, possible conflict of interest of the researchers, and patenting of intellectual property. The base of the university's relations with industry in the R&D domain is the process of technology transfer.

The technology transfer process should be very clear, fully controlled by the university or its agents, backed with regulations and with answers

to difficulties that may arise. University-industry relations may prove to be very beneficial and rewarding to both university researchers and industry. But as we combine these two different entities, many difficulties may arise and the contacts might become fragile and counter-productive. The university strives to achieve excellence in science, while industry is committed to demonstrating profits and a satisfactory balance to its shareholders on an annual basis.

An effective interface such as Yissum, in the case of the Hebrew University, can play a positive role for the short and long term in building contractual relationships with industry. The contact between university and industry is very important to both parties and it is of great importance to the national economy.

The contacts bring to the industry new ideas, new technologies and raw material for new advanced products. The university obtains more research funds, income from royalties and also achieves its goal of contributing to society. There is a great amount of knowledge being generated at universities and it is both the university's and industry's responsibility to open the gate to technology transfer for the welfare of mankind.

The situation that has emerged during the past two decades differs from that prevailing in previous years, where the aim of the university was to create and preserve know-how and to transmit knowledge to students. Today universities have become leading producers of new knowledge. The gap between basic and applied research is much narrower than it was in the past and offers major opportunities for joint collaboration between universities and industry in R&D.

The challenge is in building the appropriate mechanisms to enable this transfer of knowledge to create technology. The mechanism developed by the Hebrew University has proven to be suitable, and

provides the answers to the unexpected scenarios and is also flexible enough to build updated tools in the future. New products of high-tech industry which began from collaboration between the university and industry, contribute to the university's income and have proven to be successful and these continue to appear, and in greater numbers.

The Hebrew University has been able to develop very intensive co-operation with industry both locally and abroad. The university achieved this goal through its wholly owned subsidiary Yisum, which was established to be the tool that creates, fosters and develops university-industry relations for the Hebrew University.

The main factors regarding the management and operation of Yisum which led to its success are numerous: the basic structure as a wholly owned subsidiary of the Hebrew University; flexibility in structure; business attitude; full autonomy in its operation; well-defined regulations; openness to the needs of industry by the management of the university; modes of operation that were developed; faith by the academic community in the ability and calibre of Yisum; the strong relations developed by Yisum with industry and with university researchers; the quality of services rendered by Yisum to the researchers.

While some fears are expressed in academic circles as to the distorting effects on basic research, and the dependency likely to be created by an over-reliance on industry funding, and on the dubiousness of some of the economic benefits likely to accrue from this interaction, it seems that this collaboration will only deepen in the future.

The growing tendency towards globalization of research, international linkages and networks, and the sheer volume of know-how emanating from Israeli universities make it more or less impossible to confine the exploitation of ideas to within national boundaries. The complexity

involved in the development of modern technologies and the limited structure of local capital markets exacerbate this process. The strategy of multinational companies further contributes to this state of affairs. They globally distribute their units as part of a risk-dispersing strategy and seek out locations on the basis of comparative advantage. Israel is seen as an attractive location for research and development operations and this process leads to the inevitability and legitimacy of exporting know-how.

The importance of developing generic technologies and clusters of research projects is likely to create an ongoing interaction between university and industry in view of the fact that the development of generic technologies bridges the gap between basic and applied research. It is at this interface that industry becomes interested and willing to support university research. The complexity of this research and its pervasiveness necessitates the support of clusters of projects.

All these processes impact on the role that the Hebrew University plays in management of university-industry relations. Yissum, the company formed to foster and activate university-industry collaboration, has responded rapidly to changing circumstances and is innovative in its responses. The evolution of the Yissum Company's activities from conventional licensing and patenting through equity positions in start-up companies to limited third-party industrial partnerships, R&D partnerships and R&D seed funds, all suggest that the Hebrew University and its subsidiary Yissum will continue to develop new forms of activities to meet the changes and challenges. This will enable the Hebrew University to play a growing role in the development of the national economy in general and that of Jerusalem in particular.

APPENDIX A

Economic developments and forecasts

The inflation percentage forecast for 1998 is 5 per cent (the lowest since 1968). The industrial production growth factor was 8.3 per cent in 1992 and is forecast to be 3 per cent for 1998.

Changes in percentages/year versus previous year			
	1996 (%)	1997 (%)	1998 (%)
GNP (fixed prices) / total	4.5	2.1	2.2
GNP / Business sector	5.2	2.0	2.5
Foreign trade export	7.0	8.0	4.0
Foreign trade import	5.7	-3.2	0.0
Trade deficit	3.5	-24.1	-10.0
Inflation rate (% during each year)	10.6	7.0	5.0
Unemployment (% of labour force)	6.5	7.7	8.3

Source: Nihul Magazine, April 1998, Volume 121.

APPENDIX B

The Hebrew University of Jerusalem

Regulations of the management

Date of Publication: 28.3.1979 Administration Regulation No. 15-001

Utilization of inventions of employees and patents in the university

1. Objective

This regulation determines the rights of inventors within the body of employees of the university, and the rights of the university in respect of inventions, registration of patents and utilization thereof in terms of the Resolution of the Executive Committee (at its meeting of 26 September 1967).

2. Definitions – for the purpose of these regulations

- (a) Service invention – an invention by an employee arrived at in consequence of his service, and in the course thereof, as defined in Article 132 of the Patent Law 5727-1967.
- (b) Invention – a product or process (including know-how, conclusions, findings, documents, research results, copyrights and rights of design) which is new, useful, usable, and which contributes to scientific or technological progress.
- (c) New invention – any invention which was not yet published in the form of an article, or scientific description, including representation in graphic form, technical drawings, demonstration in scientific exhibition or lecture in a public forum.
- (d) 'Filing of a patent application', 'patent application' and 'patent' include also 'filing of a design application', 'design application', and 'design', both patent design and industrial design.

- (e) Employee – person in permanent or temporary employment of the university, or employed in any other form of engagement, including an employee on sabbatical leave or on tour of advanced studies on behalf of (or financed by) the university, or on leave of absence without pay.
- (f) Inventor – including several partners to the same invention.

3. Yissum

- (a) Functions – the university has registered a company by the name of Yissum – Research Development Company of the Hebrew University of Jerusalem (hereinafter Yissum) which acts as an arm of the university for the purpose of dealing with inventions, registration of patents and their utilization and representation of the university in all matters relating to commercial and industrial utilization of the results of the research conducted therein.

Note: Yissum is wholly owned by the university and the university's authorities have a controlling vote in its management and general meetings.

- (b) Powers – Yissum is empowered, inter alia,
 - (1) To determine whether the university has rights in an invention of an employee.
 - (2) To decide in respect of an invention of an employee, whether to seek protection for it.
 - (3) To take all steps required to obtain protection for the invention, including prosecuting in the name of the university, with the approval of the management of the university.
 - (4) To define the lines of action and the type of engagement regarding the commercial and industrial utilization of the

patents and inventions and to negotiate with commercial and industrial institutions or bodies and enter into any agreement in connection therewith.

- (5) To manage and organize the rendering of services on a commercial basis, the commercial and industrial production and utilization of patents and inventions carried out within the university, for it or in connection with it.
- (6) To define the rules regarding secrecy, including the conditioning of its action for the protection and the commercialization of the patents and inventions by restricting the publication of the inventions in writing or their disclosure by word of mouth.
- (7) To decide on the university's waiver of its rights to an invention.

4. Notification of an invention

- (a) An employee will notify Yissum of any invention, such notification will be made in writing, as closely as possible to the time of the invention, and will contain a detailed description of the invention and, if necessary, it will be accompanied by drawings and designs.
- (b) When an invention is reached at by more than one person, the notification should specify the names of the inventors and the division of rights between them, such notification to be signed by all inventors concerned.
- (c) A notification claiming rights in an individual or shared invention must bear the confirmation of the head of the academic unit wherein the invention was made.

5. Obligation of secrecy

- (a) As long as an application for a patent in respect of a service invention has not been filed, and as long as Yisum has not notified the inventor in writing that it has no intention of exploiting the invention in any way and that the university waives its rights to the invention, as in Clause 6 below, neither the employee nor any other person to whom the matter has been confined will reveal or publish details of the invention (Article 141 of the Law) without Yisum's permission, and it is to be treated as secret material.
- (b) Notwithstanding anything in Clause 5(a) above contained, an employee may publish a service invention in the following cases:
 - (1) Yisum has notified the employee in writing that the university has no rights in the invention.
 - (2) Yisum has notified the employee in writing that the university has rights in the invention, but has no objection to the publication requested by the employee as the publication does not affect the possibility of patenting the invention concerned or its utilization in any other manner.
 - (3) Yisum has notified the employee in writing that it has no intention to apply for a patent in respect of the invention or to exploit it in any other way.
- (c) Notwithstanding anything in (a) above contained, Yisum has the right to reveal details of an invention, in respect of which it has no intention to file a patent for the purpose of its commercial utilization, while reserving the rights of the university and its inventors.

6. Notification by Yissum to an employee

- (a) On receipt by Yissum of a notification, Yissum will inform the employee as soon as possible and not later than 60 days after the receipt of the notification as follows:
 - (1) Whether the university has any rights in the invention.
 - (2) The extent of the university's rights in the invention.
 - (3) Whether it intends to apply for a patent.
 - (4) Whether it intends to utilize the invention without registration of a patent, when the invention is not patentable, or for any other reason.
- (b) Yissum may extend the date of notification for an additional period of 120 days, provided that it has informed the inventor of this. The inventor being notified of the extension of the period may, without prejudicing the university's rights, and after informing Yissum, apply for a patent on his invention. If it will be determined thereafter that the university has rights in the invention, the ownership of the patent application and the patent will be transferred to Yissum, and all expenses incurred in the submittal of such application will be refunded to the inventor.
- (c) If Yissum notifies the employee that it has no intention to file a patent or to utilize the invention in any other way, then the rights to the invention will belong to the inventor, unless Yissum will notify the inventor within a year from the above notification, that Yissum has the intention to file a patent in respect of that invention or to utilize it in any other way.

7. Submittal of a patent application

(a) Applications for patents in respect of service intentions

(1) Obligation of an employee to submit details of invention:

When the university has rights in an invention, or when Yisum has decided to submit an application for a patent, the employee has to comply with all the instructions given to him, to render full assistance with regard to the submission and handling of a patent application on such invention, and to sign any documents required thereto.

(2) If Yisum decides to apply for a patent, the employee must

reveal all details connected with the invention (Clauses 139 and 140 of the Law) and do everything required by Yisum for the protection of the invention. The employee may not contact any person or body, apart from the university or Yisum, in any matter relating to testing, experimenting or utilization of his invention, without the prior written consent of Yisum. Yisum will take all the necessary steps required for the registration of the patent and its utilization, and will bear the expenses incurred in connection therewith.

(3) If Yisum has seen fit to submit an application for a patent

in respect of an invention of which notification has been given to Yisum even before a decision is made as to the owners of rights in the invention - it may do so without prejudice to the rights of the inventor or the university.

(4) As long as Yisum has not informed the inventor of its

decision to extend the date of notification, as set out in Clause 6(b) above, the inventor shall not register the patent on the invention, or utilize it in any manner other than through Yisum or in co-ordination with it.

- (5) If Yissum has decided not to apply for patent in respect of an invention in which the university has rights, after having informed the inventor accordingly, in terms of Clause 6 above, the inventor may apply at his own expense, and without the university bearing any responsibility in connection therewith, for a patent in respect of his invention in one or more countries. Such application will not prejudice the rights of the university or Yissum to demand and receive their share of the profits from the invention, as stated in Clause 8(b) and/or 11(b) below.
- (6) Until a final decision has been reached by Yissum as to the rights of the university in the invention, the employee will be deemed to have submitted the application as a trustee of the university and the university will own all rights in the invention which is the subject of the application for a patent.
- (7) Applications for patents abroad: If Yissum has registered an application for a patent in respect of an invention which the university has rights to (as stated in Clause 7(a)(2) above) or if it has been determined that the university has rights in the invention (as stated in Clause 7(a)(5) above) and Yissum has decided not to apply further for a patent in respect of the invention, or has decided to submit an application for a patent in a limited additional number of countries only, it will inform the inventor thereof, not later than 10 months from the date of the registration of the initial application for a patent. Yissum having so notified the inventor may, at his own expense and without the university bearing any responsibility in connection therewith, apply for a patent on his invention in the

countries in which it has been decided not to submit an application for a patent, and without prejudice to the rights of the university to demand and receive its share of the profits which will accrue to the inventor, as stated in Clause 8(b) and/or 11(b) below.

- (8) Expenses connected with the submission of an application for a patent: Expenses incurred by the employee in the submission of an application for a patent (as stated in Clause 7(a)(5) hereof) will be borne by the employee, who will not be entitled to reimbursement thereof, in whole or in part, except in a case where it has been finally determined (as stated in Clause 6 above) that the university has rights in the invention. In such a case the employee will be reimbursed with part of the expenses incurred in proportion to the university's share in the invention, unless Yisum decides upon a higher proportion.

- (b) Applications for a patent in respect of inventions which are not service inventions

An employee having received notification (Clause 6 above) that the university has no claim to the invention, or any rights therein, may either on his own or together with other persons submit an application for a patent.

8. The extent of the university's rights in an invention of an employee

The substance and extent of the rights of the university in an invention to which the provisions of Clause 4(a) apply, will be determined by Yisum according to the following principles:

- (a) All rights in an invention will belong to the university if it is in the field of the employee's work or in the framework of his

functions in the service of the university.

(b) In any other event the extent of the university's rights in the invention will be determined, *inter alia*, by the following factors:

(1) The nature and the extent of the connection between the invention and the employee's field of activity, his functions or the functions of the unit in which he was employed.

(2) The extent of the employee's use of funds or equipment or other materials of the university and the services rendered to him by employees of the university for the purpose of his invention.

(3) The extent of initiative put in by the employee in the invention.

9. Claim to ownership in an invention

(a) If an employee claims ownership in an invention and Yissum has not notified him to the contrary within 180 days from the date of receipt of his claim, the invention will become his property.

(b) In case of a dispute whether the invention in respect of which notice has been given by the employee, is a service invention or not, Yissum or the employee may, on the expiration of three months after the date of notification apply to the Registrar of Patents to give a ruling on the dispute.

10. Service invention financed by an external research budget

Any service invention resulting from research conducted at the university and financed by an external body will be assigned to Yissum by a document of Assignment in order to enable the university to comply with its obligations towards the organizations

financing the research. For this purpose every inventor will, on giving notification of his invention as stated in Clause 4 above, furnish details of the organization financing the research and Yissum will report on the invention to the organization financing the research.

11. Distribution of income from inventions

- (a) A service invention: From the net income derived from any invention utilized through Yissum, the inventor and heirs succeeding him will receive one third, the remaining two thirds will be used for the following purposes:

- (1) One third will be devoted to scientific research in which the inventor is engaged or interested in the framework of the unit wherein the inventor is employed in the university. Should the inventor end his employment in the university then this third will be devoted to scientific research in the framework of the unit wherein the inventor was employed in the university.
- (2) The last third will be used for the promotion of Yissum's general purposes.

In special cases a committee of four (Rector, Vice-President, Chairman of the Authority for Research and Development of the university or a representative of any of them, and a representative of the professional union to which the inventor belongs) may rule whether, at the request of the employee-inventor, or of Yissum, to divide the income in a different manner, but the Committee will not make a retroactive decision in prejudice to the employee.

- (b) A service invention in respect of which Yissum has decided not to request a patent: Notwithstanding anything in sub-clause (a) above contained, when Yissum decides not to request a

patent in respect of a service invention, and the inventor has registered the invention in his own initiative, subject to Clauses 7(a)(5) and 7(a)(7) above, the inventor and his heirs succeeding him will be entitled to half of the net proceeds and the other two quarters will be used for the following purposes:

- (1) One quarter will be devoted to scientific research in which the inventor is engaged or interested (as stated in Clause 11(a)(1).
- (2) The last quarter will be devoted to the promotion of Yissum's general purposes.
- (c) An invention which is not a service invention: In respect of an invention which is not a service invention and in which the employee was assisted by Yissum in the utilization thereof, the distribution of the income and expenses will be determined by a special agreement between the employee and Yissum, or in the absence of an agreement the inventor and Yissum will bear the costs and divide the income equally between them.

12. Responsibility

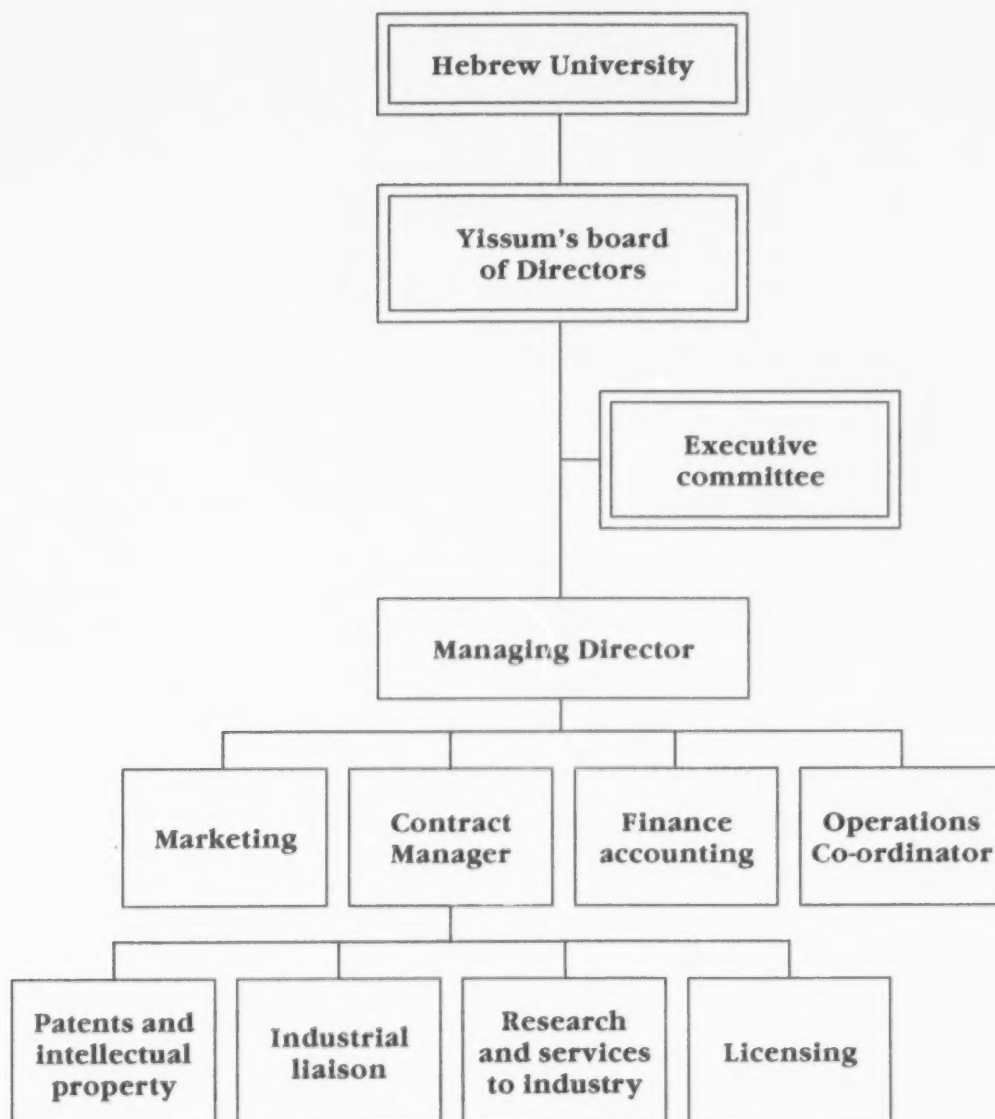
Yissum is responsible for the implementation of these regulations.

13. Applicability

- (a) These regulations will come into force from the date of publication.
- (b) These regulations cancel previous university regulations dealing with registration of patents, exploitation of inventions and inventors' rights.

APPENDIX C

The organizational structure of Yissum



APPENDIX D

General guidelines for the costing of projects for the research team

Salary:

Chief researcher
Researchers
Technicians
Secretarial workers

Equipment:

Permanent
Expendable
Glassware
Other
Computers

Materials

Seminars

Professional literature

Trips

Various

Overhead (35 per cent)

**THE MANAGEMENT OF UNIVERSITY-INDUSTRY RELATIONS
IN PAPUA NEW GUINEA**

by

M.A. Satter and J. Pumwa

THE MANAGEMENT OF UNIVERSITY-INDUSTRY RELATIONS IN PAPUA NEW GUINEA

1. Introduction

University-industry co-operation can be of considerable benefit to both institutions. Close university-industry co-operation is well developed in industrialized countries, but it seems to be somewhat lacking in developing countries. Universities in developing countries could do more to enhance their co-operation with industries. Universities could more effectively co-operate with industry by (i) adapting engineering curricula to suit industrial needs; (ii) offering continuing education to practising engineers; and (iii) promoting scientific research and transferring research results to industry. Industry, on the other hand, can help the university with necessary financial assistance for education, research and service.

This paper examines existing university-industry relations in the above-mentioned spheres of activities in Papua New Guinea (PNG) and explores the ways to improve university-industry relations through better management.

2. Papua New Guinea (PNG)

Mainland Papua New Guinea is located within the Southern tropics on the eastern half of the island of New Guinea, 160 kilometres north of Australia and east of Irian Jaya, a province of Indonesia. Mainland Papua New Guinea and about 600 offshore islands comprising the country are approximately 461,693 km² in land area. Its heterogeneous population of nearly five million mostly live in the highland valleys of the mainland, but about 15 per cent of the population live in 10 urban areas. PNG's capital city is Port Moresby with over 250,000 residents. Other important towns and cities are Lae, Madang, Wewak, Goroka,

Rabaul and Mt. Hagen. The country is inhabited by numerous tribes, speaking over 800 languages. Because of cultural and linguistic diversity, English is the language of government, commerce, law, and education in high schools and tertiary institutions.

Practically all of the larger islands are volcanic and rugged and covered with thick rainforests. Surface transportation is extremely limited and the most common way of travel is by air. The population is distributed thinly across the land and in the form of villages isolated from each other, making provision of infrastructure such as electricity, telephone, water supply and roads to these communities very difficult and costly. These geographical and social conditions of the country have had profound effects on education and, in particular, technical education.

Papua New Guinea is endowed with considerable natural and mineral resources. The main agro-forestry-industrial resources are timber, coconut, tea, coffee, cocoa, rubber and oil palm. There is a very good potential for cereal and livestock production because of fertile land and high rainfall. The land is not fully utilized for agro-industrial activities. Fish and seafood resources are abundant around the shores of Papua New Guinea islands, but near and deep-sea fishing facilities are almost non-existent at present. Papua New Guinea is also endowed with mineral resources such as gold, silver, copper, oil, gas etc. Gold and copper mines are currently being exploited. There is also small-scale exploration of oil and gas. Hydroelectric energy potential is good in Papua New Guinea.

3. Major industries in PNG

Papua New Guinea's industries may be grouped into three major categories, namely, mining and petroleum, manufacturing, and the agricultural processing industry. Government departments and small

private industries are excluded from this list. Mining and petroleum represent the largest industrial sector, comprising 12 medium to large industries. Several small-sized mining industries are also appearing in various parts of the country. These industries explore and extract mineral resources such as gold, silver, copper, oil and gas. This sector is also the largest contributor to the country's economy.

The manufacturing industrial sector comprises about 50 small to medium-sized industries whose products range from plastic products, food products, bakeries, paints, cigarettes, cement, steel products, machinery and equipment, etc. Most of the industries are located around Lae, Port Moresby and Madang.

Agricultural industries number about 12 located in different parts of the country. They deal in such items as tea, coffee, cocoa, coconut, sugar and palm oil.

Most of the industries in mining and petroleum, manufacturing and agricultural processing are partly foreign owned and managed. The ratio of local to expatriate engineers is of the order of 25 per cent.

4. Engineering and science education in PNG

There are only two well-established universities, namely, the University of Papua New Guinea and the Papua New Guinea (PNG) University of Technology. Four more new universities are gradually being set up.

The PNG University of Technology in Lae is the only technological university in the country. Entrants are enrolled in the common Foundation Year Engineering (FYE) course in their first year. At the end of the Foundation Year they are streamed into one of the four engineering departments viz. Civil, Electrical and Communication, Mechanical and Mining Engineering.

The majority of students at universities and post-secondary institutions in PNG receive National Scholarships for tuition fees, board and lodging, airfares from and to their home provinces, books, and stationery. A small percentage of students pay their way through university and some others are sponsored by private industries.

The average annual turnout of graduates in the engineering programme (Bachelor of Engineering) from the PNG University of Technology and thus in Papua New Guinea, based on the data in recent years, has been 70. The majority of the graduates are absorbed into the workforce without much difficulty. At the present time, only 20 per cent of engineers in the country are 'nationals'. Considering the supply and demand side of the equation, it is noted that the country's need for engineers outstrips supply by a margin of 5 to 1. Even in the year 2000, it is predicted that the number of 'national' engineers will form only 25 per cent of the requirement. The PNG University of Technology enrolled 168 students into its Foundation Year Engineering Course in 1996. Noting the current social and economic conditions of the country, it seems that there will be an increase in the annual rate of intake, and thus the number of graduates in engineering disciplines will moderately increase in the near future.

In addition to the four engineering departments, there are nine other departments in the PNG University of Technology. They are the departments of Agriculture, Applied Physics, Applied Sciences, Architecture and Building, Business Studies, Forestry, Language and Communications Studies, Mathematics and Computer Science, and Surveying and Land Studies. The activities of these departments are closely linked to technological development programmes of the country.

Apart from the PNG University of Technology, there are seven Technical Colleges located in Arawa, Goroka, Lae, Madang, Mt. Hagen, Port Moresby and Rabaul. The colleges offer diploma and technician-

level programmes. Other related colleges include three Agriculture Colleges at Mt. Hagen, Popondetta and Rabaul, two Forestry Colleges at Bulolo and Lae, one Forest Research Institute at Lae and one Fisheries College at Kavieng. The colleges maintain close co-operation with industries and research institutes.

5. University-industry co-operation

University-industry relations started in 1973 when the former PNG Institute of Technology was upgraded to PNG University of Technology. Co-operation began to take shape over the years as more and more industries were set up and their engineering manpower requirements grew proportionately. University-industry co-operation may be categorized as follows.

- Undergraduate programmes
- Industrial training
- Postgraduate programmes
- Sponsorship and Scholarship
- Short courses
- Donations (equipment, computers, cash)
- Consultancy
- Funding of teaching positions
- Research
- Prizes
- Conferences/Seminars
- Exhibitions
- Staff exchange
- Research funds

These categories of university-industry co-operation are not mutually exclusive but interdependent.

5.1 University co-operation

As mentioned earlier, the four engineering departments of the PNG University of Technology offer civil, electrical and communication, mechanical and mining and mineral processing undergraduate engineering programmes. The present annual turnout of graduates from

these departments is about 70, but this figure is expected to increase in the future. The present annual turnout of graduates from the PNG University of Technology is around 290. This figure excludes the diploma and certificate holders. Engineering graduates can easily find employment with industries, private businesses and government departments.

The PNG University of Technology offers several postgraduate (PG) diploma and Master of Philosophy (M.Phil) programmes. Each PG diploma programme is a combination of taught course work and a project. M.Phil programmes are entirely research based. They are primarily intended to train Assistant Lecturers who would eventually take up training positions in the university. The minimum duration of the PG diploma and the M.Phil programmes is two years.

The University of Technology has over the past eight years, 1990-1997, awarded a total of 29 PG diplomas and 9 M.Phil degrees. The department-wise distribution of the 29 PG diploma awards is as follows:

Agriculture	10
Architecture and Building	3
Civil engineering	2
Surveying and Land studies	14

The 9 M. Phil degrees distribution:

Agriculture	1
Applied sciences	3
Forestry	1
Surveying and Land studies	1
Electrical engineering and Communications engineering	3

Industries in Papua New Guinea have not yet shown keen interest in the PG programmes, probably because they are reluctant to send their employees away for long periods such as a semester or more at a time.

The Mechanical Engineering Department has started a new M.Tech programme that is expected to facilitate participation of practising engineers from industry. Residency at the university is not a requirement. The programme is a combination of taught course work and dissertation. It is based on a modular system. Intensive teaching is conducted over a period of three weeks per semester, followed by assignments by correspondence. The dissertation topic is based on industrial problems.

On short courses and consultancies, the PNG University of Technology has established a good reputation with industry. On average, the university offers about 90 short courses annually to participants from industry, private businesses and government departments. Commercial activities such as short courses and consultancies are channelled through Unitech Development and Consultancy Ltd (UDC), the commercial arm of the university.

The PNG University of Technology supports research activity through research grants and travel grants for conference attendance. Over the six-year period from 1991-1997, the university had allocated about US\$500,000 for research projects and US\$220,000 for conference travel. The total number of articles published in journals and conference proceedings over the same six-year period exceeds 500 articles. The university attracted very little research funds from PNG industries.

Both the University of Papua New Guinea and PNG University of Technology conduct in turn biennial seminars known as 'Waigani' and 'Huon' seminars respectively. These are national seminars designed to

encourage co-operation between the universities and industries, private businesses, government departments and the community at large. Various departments of the universities conduct national and international seminars in the area of their expertise. Besides, most departments conduct periodic (bi-weekly/monthly) seminars. The University Research Committee organizes biannual lectures on current research topics. Industries, private businesses, government departments and members of the public are regularly invited to lectures, seminars and conferences.

On staff exchange programmes, various departments invite industry staff to deliver lectures and attend advisory committee meetings.

5.2 Industry co-operation

The University of Papua New Guinea (UPNG) and the PNG University of Technology continue to receive co-operation from industry in various forms mentioned earlier.

A survey was conducted through a questionnaire sent out to 70 industries and business organizations to determine the type and level of their co-operation with universities in Papua New Guinea. The industries were of various sizes and types including those in mining and petroleum, manufacturing, agriculture and other sectors of the economy.

Thirty-two replies were received representing 45 per cent of the sample organizations. Of those that replied, 13 (41 per cent) industries had some form of co-operation, 19 (59 per cent) did not have any co-operation with universities. Forms of co-operation included, in order of importance: industrial training, donations and prizes, sponsorship and scholarships to students, consultancies, short courses and research. When asked about initiating future co-operation with universities, 27 (84 per cent) replied 'yes', while 5 (16 per cent) were undecided.

As noted above, industrial training is the most cited form of co-operation between the university and industry. Students of the PNG University of Technology undergo industrial training for periods varying from 6 weeks to 30 weeks depending on the course of study. Sandwich-stream students in the department of mechanical engineering undergo a minimum of 30 weeks training. Over the last eight years, 1990-1997, the department was able to place 95 students to 19 industries. Over the same period, students of other departments of the university were accepted by various industries for industrial training.

Industries and private business organizations financially support the university education of many students. There are at present 56 industries and organizations that support about 320 students (~ 20 per cent) through sponsorships and scholarships. A similar number of students of UPNG are also supported financially by industries and private business organizations.

Industries and business organizations award about 200 prizes annually to students of the two universities.

Papua New Guinea's industries have made donations of cash, equipment and computers to academic departments. The Mining Engineering Department at PNG University of Technology is an example of such university-industry co-operation. A teaching position in the same department is being funded by industry.

6. The management of university-industry relations at PNG University of Technology

The two main universities, namely, the University of Papua New Guinea (UPNG) and the Papua New Guinea University of Technology (PNGUT), have established their respective commercial arms through which they conduct commercial activities. The commercial arm of

UPNG is known as *Unisearch PNG Pty Ltd* while that of PNGUT is *Unitech Development & Consultancy Pty Ltd* (UDC). Both of these commercial units have similar policies and procedures. It is therefore sufficient to consider one of them. We shall consider UDC, the commercial arm of PNGUT.

6.1 UDC – Company profile

Unitech Development and Consultancy Pty Ltd (UDC) is the principal private company and corporate arm of the University of Technology. Its origin followed initial approval by the Council of the University of Technology in 1987, but actual operations began after it was formally incorporated as a company in March 1992. It is registered under the PNG Company's Act – Registration No. 011915 – and is limited by shares.

The relationship between PNGUT and UDC is symbiotic, they need each other to thrive. Directors of UDC as a company also happen to be Council members of the university. UDC is owned by PNGUT, but financially UDC is quite an autonomous private company.

The mission of UDC is to offer the best professional expertise, research and technical services to government institutions, commerce, industry and the community, through its direct link with the University of Technology as a pre-eminent technological institution in Papua New Guinea and the South Pacific region. UDC is able to offer a much wider range of renowned expertise on consultancy services, usually at cost-effective and highly competitive rates. In fact all disciplines through which the university offers academic teaching and research, subject to the availability of spare man/hours, can be drawn on as consultancy services.

UDC operation is governed through the company's Board of Directors' membership, which is drawn from the University Council.

UDC Board's directives are implemented through the company via an Executive Manager, down through to managers of subsidiary commercial units. Subsidiary units of the company include UDC Architects Pty Ltd, Audio Visual Unit, Civil Engineering Commercial Unit, Electronic Services Unit, Unitech Guest House, Rainforest Habitat (RFH), Management Development Centre, Mechanical Engineering Workshop, National Analysis Laboratory (NAL), and Veterinary Clinic.

The company's annual turnover averages 2.5 million Kina per annum, with assets worth in excess of 1 million Kina. UDC employs 57 full-time staff, of which four are overseas contracted staff, namely the chief chemist, the senior chemist and two managers for the Insect Farming & Trading Agency (IFTA) and Rainforest Habitat. The 57 full-time employees mentioned are neither academics nor full-time employees of the university. They in fact represent mainly casual, administrative and technical staff at NAL, RFH/IFTA, Guest House and UDC Head Office. The point worth clarifying is that consultants for UDC are not full-time employees of UDC per se; rather they are drawn from time to time or as and when required from the academic and technical staff of the university. Consultants are paid at specified rates and are expected to take roughly 20 per cent off from their teaching time to undertake consultancies as enhancement to their academic teaching and research tasks. 'Consultants' are full-time employees of the university on a part-time engagement to undertake UDC consultancies. UDC's main office has a full-time accountant and administrative support staff which provide overall managerial service. All financial control and corporate affairs are managed by the main office under the Executive Manager.

The University of Technology is the sole beneficiary of profits and in-kind support that UDC generates through its operations. Whilst the university provides some office space and limited funded research positions on a diminishing scale, UDC has been financially self-supporting for the last seven years of service.

6.2 UDC – Commercial service units

UDC has 10 subsidiary commercial units. They include:

- (i) UDC Architect Pty Limited
- (ii) Audio Visual Unit (AVU)
- (iii) Civil Engineering Commercial Unit (CECU)
- (iv) Electronic Services Unit (ESU)
- (v) Unitech Guest House
- (vi) Rainforest Habitat/Insect Farming and Trading Agency (IFTA)
- (vii) Management Development Centre (MDC)
- (viii) Mechanical Engineering Workshop
- (ix) National Analysis Laboratory (NAL)
- (x) Veterinary Clinic

Activities of each of the subsidiary commercial units are briefly described under item 6.3. Apart from the UDC commercial units, university departments and individual staff provide consultancy and short-course (continuing education) services to industry and the community as a whole.

6.3 UDC – Capabilities

UDC offers direct services through its own commercial service units as well as through university departments and individual staff. In the latter case, university staff automatically become UDC consultants in their respective fields. Much of the strength of UDC lies in providing consultancy and short courses.

Consultancies

Naturally UDC consultants perform a dual role. Apart from their distinct and highly specialized professions, they are also, by necessity,

HRD specialists, thereby creating a multiplier effect. A further bonus is the fact that UDC has both a multi-cultural and multi-disciplinary core of professionals, most of whom could be called upon at short notice to undertake consultancy work. Additionally, through existing linkages and associations with allied consultants, UDC is able to form and undertake joint or partnership consultancy work, particularly where development programmes' magnitude and cost entails external donor funds. Although most consultancy work is undertaken by staff through the academic departments, external full-time consultants can be engaged as determined under appropriate partnership arrangements. For staff of the university, consultancy work provides the opportunity to gain further professional experience through practice and by developing entrepreneurial skills. A list of consultancy projects appears in *Appendix A*.

UDC's role in procuring consultancies is determined by the availability of expertise at PNGUT. UDC advertises as a company and assigns requested consultancies to relevant departments. Consultants are also free to secure direct consultancy assignments.

Short courses

Although the primary purpose of the university is to educate young people to take their place in a rapidly developing society, the university is also mindful of the needs of business and government to update the skills of the existing workforce. The various departments of the university through UDC prepare and offer a wide variety of short courses each year to meet such needs. These courses will continue to develop, expand and alter to meet the changing needs of the community. Short courses can also be tailor-made to suit specific employer or industry needs. A list of selected short courses appears in *Appendix A*.

The formats for consultancy and short course applications also appear in *Appendix A*.

UDC Architect Pty Limited

UDC Architects Pty Ltd provides professional architectural services to individuals and the community at large. Through this subsidiary, the Department of Architecture and Building offers its expertise for commercial use. As a result of its leading role in the education and training of young Papua New Guinean architects, staff are well positioned to offer services that recognize the unique nature of PNG traditional architecture.

Audiovisual Unit

The Matheson Library has a team of specialized technical staff working in its Audiovisual Unit. This group of talented young Papua New Guineans has the abilities and skills necessary to expand beyond simply serving the internal needs of the university. Services include photographic work, black and white production, video footage, tape dubbing and video editing. In recent months the unit has been involved in short documentary assignments.

Civil Engineering Commercial Unit

The Civil Engineering Commercial Unit operates within the Department of Civil Engineering and offers a comprehensive range of testing and consultative services in support of business throughout the country. Testing services include compressive and tensile strength of building materials.

The Department's testing facility is a certified laboratory and, as such, maintains and continues to develop a comprehensive group of qualified technical staff whose know-how ensures that the Civil Engineering Commercial Unit continues to fill the needs of local industry, especially the construction industry.

Electronic Services Unit

The Electronic Services Unit currently operates an electronic workshop and offers repair and maintenance services to the various university departments and outside clients on a commercial basis. The Unit repairs computers and other electronic equipment such as television sets, video record players, video cameras, radios and scientific equipment. This unit is being expanded with a view to importing computer components and having them assembled in Lae.

Unitech Guest House

The UDC operates a Guest House on behalf of the university and provides comfortable and inexpensive accommodation to service the needs of the campus community. In addition to official university needs, the Guest House caters to those attending short courses, conferences and seminars by providing full board and lodging facilities.

Rainforest Habitat/Insect Farming and Trading Agency (IFTA)

Situated on the campus of the university, the Rainforest Habitat forms part of the Unitech-owned Insect Farming and Trading Agency. This community development project provides income for over 1,200 village farmers and collectors. The Rainforest Habitat occupies some 3,000 square metres of the 10-hectare project site and is a concentrated mix of animal and vegetation diversity, all enclosed in an 11-metre-long high canopy. The IFTA is an internationally recognized and well-respected organization providing live and preserved specimens of Papua New Guinea's unique butterflies and insects to overseas collectors, museums and researchers.

Management Development Centre (MDC)

In 1986 the University Council established, through UDC, the Management Development Centre (MDC), to provide Papua New Guinea with a much-needed source of specialized management training

for its already existing workforce. Since then MDC has provided and continues to run numerous management courses at regular intervals throughout the year. Short courses include accounting, personnel management, computer courses, financial management etc.

Mechanical Engineering Workshop

The Department of Mechanical Engineering maintains a workshop supporting not only internal university needs, but is also available commercially to the community at large. The facilities available include precise computerized equipment capable of manufacturing goods to very fine tolerances. Specialized technical staff within the Department provide students with important training and are also available to serve the needs of the wider community.

National Analysis Laboratory (NAL)

The National Analysis Laboratory (NAL) was created as a result of the university's constant efforts to maintain the highest standards of a commercial analytical chemistry-testing laboratory. As a result, NAL is fully equipped and staffed and is accredited to the Papua New Guinea Laboratory Accreditation Scheme (PNGLAS), providing services at an internationally recognized standard of excellence. The NAL provides the university with access to world-class facilities for its staff, students and academic researchers. In addition, the Laboratory has contracts with many of Papua New Guinea's major industries, including mining companies such as Porgera Joint Venture. Analytical services include the testing of the fertility status of plants and soils, protein analysis of stock feed and foods, mineral analysis of waters, testing of waters for potability, pollution testing of effluent etc. The NAL also operates a modern pathology laboratory where pathological testing of human blood, urine and stools is undertaken using modern instrumentation.

Veterinary Clinic

The Veterinary Clinic operates from within the Department of Agriculture and not only supports the educational and research needs of the Department, but also offers its facilities commercially as a service to the campus and local community.

Exhibits

UDC, through its network of expertise within the university, can offer short courses and consultancy work on a wide range of areas, from developing short-course training programmes, feasibility studies, project design to project management. Although UDC's clients are generally from the PNG government departments, statutory bodies, mining companies, provincial governments, local companies and business groups, co-operative arrangements with overseas development partners, as required for donor-funded development projects, can also be executed in line with specific tender requirements.

6.4 UDC – Management and accounting policies and procedures (Appendix B)

UDC has a well-developed set of procedures for its staff management and accounting procedures, as detailed in Appendix B. These were compiled and published in January 1997, with the purpose of streamlining business practices among its business units, and various university departments and individual consultants. The document outlining the policies and procedures contains three main sections:

- Section A: Accounting policies and procedures
- Section B: Management policies and procedures
- Section C: Policies for UDC employees

The accounting policies and procedures deal with invoice preparations, purchase orders, cheque requisition, payroll requisition, per diem and cash advance, issuing of receipts, posting of receipts, posting of expenses and statement of accounts. Appropriate printed forms for the various procedures mentioned above are available from UDC. UDC employs a full-time accountant, separate from that of the university, for the various accounting activities under the supervision of the UDC Executive Manager. The accounting procedures are applicable to the various commercial units, university departments and individual consultant staff.

Section B, dealing with management policies and procedures, is fairly comprehensive, dealing with as many as 23 items. They include such procedures as consultancy approval, transfer of funds, operation of personal and departmental trust accounts, tender preparation, warranty, ownership of reports/patents, professional fees and rates, insurance, code of ethics, purchase and ownership of project equipment, profit-sharing modes, etc. Again, various relevant forms for these procedures, including those for projects and short courses, are well established and available from the UDC office.

The surpluses have so far largely been confined to internal enhancement of the company's development projects, such as the Rainforest Habitat and administration. Given that 65 per cent of consultancy fees are paid directly to consultants as part-time employees, the percentage return to UDC as the employer is unusually low at 25 per cent. The remaining 10 per cent goes to the university.

The rationale for such percentage distribution is supposedly one of fairness, but there are still grumbles.

UDC follows market penetration strategy and, generally, costings are below market prices time-wise, but related services are at full-cost prices.

All overheads should ideally be charged to the project costs, but it is quite possible that overlapping of similar tasks, as required for academic teaching and research, render opportunity for cost sharing with PNGUT. UDC does not ask and has not been charging any handling fees. The 10 per cent referred to is, in fact, a withholding tax provision which is collected by UDC on reimbursement of claims for goods and services that are either not strictly related to academic teaching and research, or provided by suppliers without a certificate of compliance.

UDC normally insists on an up-front instalment of at least 20 per cent of project cost.

Commitment to work in the area of continuing education and consultancies may contribute towards promotion of the consultants provided that work is published in reputed journals. It may be mentioned that the university and UDC are different employers and of course academics are mainly expatriates on fixed contracts.

In most cases, academics do adhere to the rules approved by the University Council and the UDC boards, but there are instances when some academics feel that the 25 per cent claimed by UDC is too much and venture out on their own to do consultancies.

Section C deals with policies for UDC employees. They include appointment and salary increments, code of ethics, bonus policy for UDC employees and consultancy work by UDC employees. It is of particular interest to note that full-time employees of UDC, including all contract officers, are not permitted to undertake consultancy work.

6.5 Technology transfer and commercialization of intellectual property

The issues of technology transfer and ownership of intellectual property are still under consideration by the university. In this connection, the Executive Manager recently wrote the following (Warvi, 1997).

The full investment potential of UDC as the commercial arm of the university, particularly in the commercialization of intellectual property rights, has not been realized both materially and financially. The potential is good, in fact the advantages are all in our favour as the premier technology institution in the country. By striving to gain and maintain intellectual excellence and capabilities, the university through UDC must, of necessity, hold exclusive rights over new technologies developed within its departments. The protection of intellectual property and sale of related new technologies under exclusive rights are areas where the potential exists for substantial investment in future; and there is nothing more to it than downright intellectual excellence. The promotional and enhancing role of UDC must accompany research and development in this respect.

Research and development of new technologies are areas that really call on the intellectual capacity of the university in its entirety as an institution of excellence in learning and research for academics and students alike. Although R&D in itself is neither a commercially viable nor profitable activity, there are prospects. UDC would act on behalf of the university for academics wishing to commercialize their inventions. By accepting the invention UDC would assign certain rights to the inventor and consequently invest in patenting and marketing. So much though for the absence of copyright laws in PNG.

It would appear that some very interesting new technologies have been, and continue to be, invented right here, but these are somehow transferred quietly abroad for security under copyright laws, from which

point, the return upon commercialization would be highly attractive. A quick look around reveals that there is one prototype coconut dehusker being tested, an electric train concept is being developed and countless other food derivatives have been successfully developed from local fruits, vegetables and tree crops. Commercialization through downstream processing and marketing of such products may be well beyond UDC's current level of proficiency, but with the ownership of intellectual property rights and the ability to maintain R&D for specific products to follow up with refinements and/or redevelopments, there is scope for improvement.

7. Evaluation of the benefits and drawbacks regarding relations with industry

There has not been a formal evaluation, either internal or external, of the benefits and drawbacks regarding the university's relations with industry. This is true for both UDC and university academic departments. There is, however, a regular annual audit of financial activities of the university, as well as the UDC, by reputed auditors. The university also has in place an internal audit mechanism.

The university has derived significant financial benefits from the collaboration with industry. This is apparent from UDC's balance sheet. Also, the fact that industry has in the past donated generously for the establishment of the Mining Engineering Department and supported two chairs, one in Mining Engineering and the other in Electrical and Communications Engineering, are indications of the financial benefits received by the university.

Apart from financial benefits, there are other advantages the university derives from collaboration with industry. They include provision of industrial training to students and staff, staff exchange, curriculum review etc.

Although the university has good success in its collaboration with industries, there seem to exist some drawbacks. These include lack of co-operation on research. The university has not been successful in attracting research projects and funding from industry. It appears that university research projects are less appropriate to the needs of industry. Besides, the time taken for university research tends to be rather too long.

Another factor for the lack of research co-operation is that most PNG industries are foreign owned, which tend to look for home-country expertise on their research problems.

According to a recent survey (Satter, 1995) on university-industry co-operation, it was suggested that co-operation on research projects could be improved if the staff-exchange programme was enhanced. This implies that some university academics should pay regular visits to industry and perhaps spend a term actually working there.

8. Future prospects for the development of relations with industry

Although the level of university co-operation with industry seems to be good, this may not be so in the immediate future because of the general economic condition of the country. The value of the local currency, the kina, has been steadily falling over the past few years. This trend, if continuous, will considerably impede industrial activities, and hence the future prospects for development of relations with industry. The same economic trend will also affect the university, which is mainly dependent on expatriate academic staff.

9. Conclusions

The university's role in providing undergraduate courses relevant to industrial needs is well established. Postgraduate and continuing education courses for practising engineers are being continually

developed. A significant level of research is being conducted and results published by university academics, but there appears to be a lack of communication in transferring the research results to industry.

PNG industries co-operate with both the universities in providing industrial training to students, assisting students financially through scholarships and sponsorships, awarding prizes to students for good performance, and donating equipment, computers and money to some academic departments.

The PNG University of Technology has a well-established commercial arm, UDC, for developing university-industry co-operation. UDC has been successful in its operation with established policies and procedures. The success of UDC depends on its ability to expand its services outside the PNGUT campus as its prime location and venue for short courses. It also needs to unload huge and unrelated expenditures such as the Rainforest Habitat. There is a need to focus attention on better research co-operation with industry. Greater frequency of exchange of staff between university-industry is essential. Academic staff should spend some time working in industry and identify research projects of interest. The future level of co-operation with industry could be impeded by the present gloomy economic trend in the country.

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APPENDIX A

A selected list of recent consultancy projects

Title of project	Description of project
1. Microsoft project instruction	To provide four days on-the-job training in Microsoft Project 4 for Daltron clients.
2. Microsoft Windows 95 and Office Training Course	Provide 'on-site' training in the use of Windows 95, MS Word 7.0, MS Access 7.0, MS Excel 7.0 and MS Power point 7.0 applications software packages.
3. Soil storage shed	Prepare building permit application for AS-built structure.
4. Survey - Vele Rumana building	Carry out building defects survey.
5. Dielectric test of live-line washing	Conduct a one-minute dry power-frequency Stick #2 Voltage withstand test of a live-line washing stick used for washing 66-kV transmission line insulators.
6. Dielectric test of live-line washing	Conduct a one-minute dry power-frequency Stick #3 Voltage stick used for washing 66-kV transmission line insulators.
7. Computer network	Supply and install a computer network consisting of a Windows NT server and three workstations.

8. ACLMP training	Introduction to Digital Cartography and MicroStation, GPS Operations and Applications, Tenure Types-Cadastre for DCDB, Geodetic Computations Refresher Course, Photogrammetric Principles, Cartographic Production and Design, GPS Operations and Computations and GIS/GPS Data Acquisition Applications.
9. Evaluation of small-scale coffee	To assess the existing coffee-processing techniques, suggest improvements and recommend and source appropriate equipment and machines.
10. Mapinfo training: Lae City Authority	AusAID Lae roads upgrading. Sizing.
11. Design and member sizing	Structural calculations and member - Extension of Eriku Lodge, Gurney St. sizing for extension of Eriku Lodge, Lae.
12. Water supply for fish processing	Water sourcing, quality and use in fish canning.
13. Markham Enterprises Marine Lease	Preparation of plans for Town Planning Project approval and construction.
14. Microbial analysis of food samples	Microbial analysis of imported frozen foods (meat, chicken, etc.) for spoilage and pathogenic micro-organisms to determine suitability for human consumption.
15. Yacht Club development	Supervision of drill rig and borehole logging.

16. Valuation of Awilunga Estate	Valuation of land and land improvements for possible purchase as NARI headquarters.
17. Umi Bridge survey	An urgent request from client to utilize staff and equipment for field survey of location and height for x sections of points along the Umi River near the Umi Bridge.
18. Arbitration hearing	To act as an arbitrator between Nivani and Air Niugini concerning a contractual dispute.
19. Feasibility study on mango (fruit)	To examine the feasibility of establishing juice processing, mango-juice processing and the manufacture of other fruit products from locally available mango and fruits in Rabaraba District of the Milne Bay Province.
20. Morobe Gold project	The vegetation assessment for the environment plan.
21. Wampar Health Centre - 1st stage	Provision of project management services development for the development of Wampar health facilities.
22. Environmental monitoring 1997	Environmental audit/monitoring.
23. Valuation of reforestation plantations	Valuation required for stamp duty purposes for transfer from Gogol Reforestation Company to Jant Timber Pty Ltd.

24. Vudal University Master Plan framework	Development of the mapping, occupation and models as a framework for the Vudal Master Plan.
25. In-house training for Telikom students	Provision of Computer Sciences instruction from 30 June to 23 October 1997.
26. Extension to Melanesian Hotel	Sub-surface investigation of the proposed extension.
27. Iviri resource inventory	Assessment of forest resource in the area.
28. Commissioning of local area network	Specification of hardware and software for local area network. Training of national staff in use of network, operating systems and applications.
29. Village-level food technology	Training workshop on processing and nutrition training utilization of cassava, cereals and legume products.
30. Upgrading of outpatients facilities	Provision of necessary drawings/specification for proposed building works and budget estimates.
31. Klockner-Moeller PLC Programme	Request for the programme decoding and Battery Charging Clarification. The main point of the project was to replace very costly foreign consultancy from overseas by Unitech's expertise.

A selected list of recent short courses/training

Title of project	Description of project
1. Advanced project planning	Introduction to advance project planning, managerial philosophy, and the planning process.
2. End-user computing	First-level diagnosis of computer problems and how to solve them.
3. Quarantine support project training	Provision Animal health and disease course • Stock inspectors • Meat inspectors • Quarantine inspectors
4. Contract procedures	The role of the contracts manager, types of contract, various conditions of contract, communication and dealing with people, preparing cash-flow budgets, forecasting and reconciliation of reports and dealing with measurements, certification and disputes.
5. An introduction to planning and managing small businesses	The course introduces the participants to planning and managing small businesses. Outline includes motives for starting a business, the product, the price, legal finances, etc.
6. Bookkeeping for small businesses	The course takes participants through the basic theories of bookkeeping. Outline includes source documents and filing, daily sales book, balancing the daily sales book, cash book, balancing the cash book, bank reconciliation, profit and loss statement, returns inwards and outwards, etc.

7. Computerized accounting for small businesses	The course takes the students through computerized accounting for small businesses. The outline includes accounting principles, double-entry accounting, types of accounts, financial statements, debits and credits using an accounting software known as Mind Your Own Business.
8. Purchasing, inventory management	Importance of inventory management, purchasing techniques and accounting for inventories
9. Total quality management and problem solving in the workplace	Quality and productivity, TQM fundamentals, customer supplier concepts, continuous improvement models, quality costs, time management, waste reduction, training of workforce, communications, interpersonal relationship and case studies.
10. Hydraulic and pneumatic control training	Review of control valves, servo valves, Course II (In-house course for NBPOL) accessories, design of hydraulic and pneumatic circuits, fault diagnosis, preventive maintenance of hydraulic and pneumatic systems.
11. Writing skills	Queensland University of Technology - Writing skills course module.
12. Resource management	Labour, plant, materials and money as resources and their management.
13. Q.A. in construction	Q.A. standards, developing and maintaining a Q.A. system, total quality management, Q.A. effects on the client, designers and the contractor.

14. General English	Practical English grammar, good English and communicative competence and secrets of successful communication.
15. Micro Hydro Power Training Workshop	Site investigation for micro hydro project.
16. Application of statistical methods in industry	Basic statistical concepts and statistical process control.
17. Hiddel Valley-Hamata business	Economic linkages and spin-off effects of the proposed new Gold Mine in the Hidden Valley/Hamata area. Costs and benefits of small-business development. Model for involvement of landowner companies.
18. Advanced report writing	Skills leading to the construction of an effective report.
19. Report writing	Report content, structure and organization. Collecting information using graphs + statistics. Selecting and organizing material, presenting findings, concluding, recommending and summarizing.

A selected list of projects under consideration

1. Preparation of an Asset Register for the National Research Institute.
2. Preparation of an Asset Register and inventory of infrastructure for East New Britain Provincial Government.
3. Preparation of an Asset Register and inventory of infrastructure for Oro Provincial Government.
4. Preparation of a master plan and physical development for the University of Papua New Guinea and its colleges.
5. Feasibility study into Arapesh Land Development for the East Sepik Provincial Government.
6. The design documentation and project management of various guest houses and water supplies along the Kokoda trail for the Tourism and Promotion Authority.
7. Post-construction monitoring and evaluation of technical and environmental effects of Busu River Bridge.
8. Co-partnership participation with Hassall and Associates of Australia in the proposal for the establishment of NARI.
9. Design documentation for a project proposal to undertake an Energy Audit of major national hospitals throughout PNG.

APPENDIX A (continued)



Project number

(Assigned by UDC)

CONSULTANCY APPLICATION

PROJECT INFORMATION

Name of client	
Address	
Contact	Telephone
Title of project	
Description of project	
Principal Consultant	Department

CONSULTANCY FEES

Description	Projected	Actual
<i>Total consultancy fees</i> → B	K	K

RECOVERY OF PROJECT EXPENSES

Description	Projected	Actual
Subtotal expenses >C		
UDC Handling fee* (10% of C) >D		
<i>Total expenses (C + D)</i> → E	K	K

TOTAL PROJECT VALUE

Fees + Expenses (B + E) >F		
Provincial Tax (3% of (B+D)) >G		
<i>Total project value (F + G)</i> → H	K	K

* Projects with total expenses over K5,000 – Handling fee is reduced to 5 per cent

PROJECT DISTRIBUTION

Return to department

Description	Projected	Actual
Standard 10% of (B)		
Other extraordinary items		
<i>Return to department</i> —————> J	K	K

Return to university/UDC

Description	Projected	Actual
Standard 25% of (B)		
Handling fees (From D)		
Other extraordinary items		
<i>Return to university/UDC</i> —————> K	K	K

Return to consultants

Participating staff	Projected	Actual
<i>Total (65% of B)</i> —————> L	K	K

Approvals

Principal Consultant	Head of Department
Date	Date
UDC	Vice-Chancellor
Date	Date
<i>Receipts acct #</i>	<i>Payments acct #</i>

Rev 3, April 1994

The management of university-industry relations
Five institutional case studies from Africa, Europe, Latin America and the Pacific region

Course number

(Assigned by UDC)

Short course application

Course information

(Part A)

Course title		
Course content		
Date(s) course offered		
Principal Instructor	% Share	Department
Other instructors		

Course fees

(Part B)

Basic course fee		K
Special course fees	(optional)	K
Accommodation charges	(optional)	K
Meal charges	(optional)	K

Attendance

(Part C)

Projected	Actual
-----------	--------

Income statement

(Part D)

Income	Projected	Actual
Basic course fees		
Special course fees		
Charges for accommodation		
Total income → D	K	K

Expense statement (Part E)

Expenses	Projected	Actual
Accommodation - Student services		
- Guest house		
- Lae hotels		
- Other		
Tea and coffee		
Lunch/dinner		
Photocopying		
Course materials		
Course Administrative Assistants		
Break-up function		
Advertising		
Instructors fees (Non-Unitech)		
Transport		
Typing costs		
Refunds		
Other expenses		
Total expenses —————→ E	K	K

Net profit from course (Part F)

Income less expenses (D-E) —————→ F	K	K
--	---	---

Application of profits (Part G)

% Share of F	Projected	Actual
Return to instructors 65% (Apportioned as in Part A)		
Return to Department 10%		
Return to university/UDC 25%		

Projected: To be completed when applying for course approvals.

Actual: To be completed after course has been conducted.

Approvals

Principal Instructor		Head of Department	
Date		Date	
UDC		Vice-Chancellor	
Date		Date	
Receipts acct #		Payments acct #	

APPENDIX B

Management and accounting policies and procedures

First issue: January 1997



**UNITECH DEVELOPMENT
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UNITECH DEVELOPMENT
& CONSULTANCY Pty. Ltd.

Memorandum

6 January 1997

To: Heads of Department
Managers of UDC Commercial Units

From: Executive Manager

**Subject: Management and accounting
policies and procedures**

Management and accounting policies and procedures herein stated have been prepared with the view of streamlining UDC business practice among its commercial units and consultants from the university.

It is anticipated that, during implementation of these policies and procedures, there will be concerns raised. UDC management will welcome written comments for revisions, additions, deletions etc. forwarded to the Executive Manager. The UDC Board will review and adopt revisions as recommended by the Executive Manager.

Sincerely,

Kora Korawali
Executive Manager

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Section A Accounting policies and procedures

A1.00 Invoice preparation

Generally all invoices of the company shall be prepared using the approved standard invoice form. An invoice must be raised stating all particulars. Sales Tax of 3 per cent must be included for all invoices unless exempted, in which case the appropriate exemption form must be filed. The following must be adhered to:

- 1.10 All invoices for consultancy work and short courses shall be raised by the UDC Office upon request by the Principal Consultant, giving details of the invoice. The original White Copy of the invoice will be forwarded to the Client. The Green Copy of the invoice shall be retained by UDC accounts, while the consultant will retain the Pink Copy in the Invoice Book.
- 1.20 The following units of UDC, such as MDC, ESU, UDC Architects, Unitech Guest House and CECU shall raise their own invoices using UDC's standard form. These units shall forward to UDC the Green Copy of the invoice.
- 1.30 The UDC Accountant will audit the invoices on a monthly basis to ensure unpaid invoices are followed up and paid for.
- 1.40 NAL, IFTA and Rain Forest Habitat shall raise their own invoices using their own approved forms. Invoices will be audited on a monthly basis to ensure debt collection is maintained.

A2.00 Purchase Orders

Generally all Purchase Orders of the company shall be prepared using the approved standard form. All Purchase Orders must be raised stating all particulars. Other UDC commercial units may use their own purchase forms, but these must be countersigned by the UDC Office. The following must be adhered to:

- 2.10 Purchase Orders for airline tickets must indicate: who is travelling, destinations, dates, flight numbers, costs, purpose of travel, project number etc. All Airline Purchase orders must have the following stated at the end of each: 'Non-refundable, no alteration unless consent of sponsor'.
- 2.20 Purchase Orders for vehicle hire and accommodation must indicate the person's name, duration of service, purpose or project number etc. Accommodation orders must indicate clearly 'with meals' or 'without meals'. Vehicle authority to drive should include all those who will drive the hired vehicle.
- 2.30 Purchase Orders for all other services, supplies and equipment must be filled in completely, showing all relevant information on particular items to be supplied, total cost and account number to be debited.
- 2.40 All departments and commercial units of UDC will be issued with official UDC Purchase Order Books. A register of Purchase Orders issued will be maintained by the UDC Accountant. Only Heads of Departments, Heads of UDC Commercial Units and other authorized officers such as the Bursar and Deputy Bursar are required to sign Purchase Orders as 'Authorized Officer'. The UDC Office will countersign all Purchase Orders as 'Budget Officer'.

- 2.50 A White Copy of the Purchase Order will be forwarded to the supplier. A Green Copy of the Purchase Order will be forwarded to UDC Accounts. A Blue Copy will be maintained by the originator of the Purchase Order. A Pink Copy to remain in the Purchase Order book.
- 2.60 Authority on Purchase Orders.
 - 2.61 Heads of Departments will have the authority to sign Purchase Orders up to the value of K10,000, countersigned by the Executive Manager.
 - 2.62 Managers of UDC commercial units will have the authority to sign Purchase Orders up to the value of K5,000, countersigned by the Executive Manager.
 - 2.63 The UDC Executive Manager will have the authority to sign Purchase Orders up to the value of K10,000, countersigned by the Bursar or Vice-Chancellor.
 - 2.64 The UDC Administrative Officer and UDC Accountant will have the authority to sign Purchase Orders up to the value of K2,500.
 - 2.65 Purchase Orders exceeding K10,000 will have the Vice-Chancellor's approval upon review by the UDC Executive Manager to ensure sufficient funds are available for such purchases.
- 2.70 Do not place orders for over K5,000 before getting a counter signature.
- 2.80 Do not break a purchase of over K5,000 into two or more smaller purchases of under K5,000 in order to avoid the necessity of obtaining approval. This will be considered unacceptable by the Auditors and the Board.

- 2.90 Issue of Purchase Orders will be consistent with university procedures.
- 2.91 Purchase Orders for purchases up to the value of K500 can be raised by verbal agreement. A quotation will not be necessary.
- 2.92 Purchase Orders for purchases over K500 and up to K5,000 can only be raised upon receipt of an official quotation.
- 2.93 Purchase Orders for purchases over K5,000 and up to K10,000 can only be raised upon receipt of a minimum three (3) official quotations. Where less than three (3) quotations are available, the Executive Manager will review the purchase.
- 2.94 Purchases over K10,000 will require tenders to be arranged through the UDC Office.

A3.00 Cheque requisition

All requests for payments must be accompanied by a UDC Cheque Requisition Form. This form is issued by UDC to all departments and UDC commercial units. Incorrect filling in of Cheque Requisition Forms will either not be processed by the UDC Accountant, or will be returned to the Originator. The following must be adhered to:

- 3.10 Details of to whom payment to be made, amount to be paid, account number to debit the payment and reasons for such payment request must be indicated.
- 3.20 Cheque Requisitions for payment of services, supplies, equipment etc. must be accompanied by an official invoice or quotation.

3.30 All Cheque Requisitions must be signed by the same authority as in the case of the Purchase Orders. Except for Payroll Requisitions, these must be signed by the requesting officer.

3.40 Cheque Requisitions for Heads of Department will be approved by the Vice-Chancellor's Office.

A4.00 Payroll requisition

Any consultant from the university wishing to make a personal withdrawal from his or her Trust Account can do so (depending on funds available) by filling in a Payroll Requisition Form with the UDC Office. Telephone requests or other written request will not be accepted. The following must be adhered to:

4.10 Payroll Requisitions will be processed through the university payroll system, taking into account income tax. Therefore requests from UDC must be a gross amount.

4.20 Payroll Requisition Forms (standard form available from UDC) must be lodged with the UDC Accountant by Monday afternoon in order to be processed and forwarded to the university Salaries Section for payment for the coming pay period.

4.30 Cash advances for personal reasons will not be accepted unless on compassionate grounds.

4.40 Payroll Requisition for Heads of Department will be approved by the Vice-Chancellor's Office.

A5.00 Per diems and cash advance

To initiate these requests, the following must be adhered to:

- 5.10 Per diems for official duty travel related to conferences, workshops, research, or project site visits etc. shall be approved by the Head of Department using a UDC Staff Expense Claim Form and a Cheque Requisition Form. These two forms must be submitted to the UDC Accountant for processing.
- 5.20 Cash advances for official duty travel related to conferences, workshops, research, or project site visits etc. shall be approved by the Head of Department using a UDC Cheque Requisition Form.
- 5.30 This form must be submitted to the UDC Accountant for processing. Upon return from duty travel, the cash advance must be acquitted using the UDC Staff Expense Claim Form approved by the Head of Department.
- 5.40 Managers of UDC commercial units requiring duty travel allowances shall submit their request to the Executive Manager for approval. All allowances including any cash advances must be acquitted.
- 5.50 Duty travel allowances, per diems etc. for Heads of Department will be approved by the Vice-Chancellor's Office.

A6.00 Issuing of receipts

Receipts must be issued for all payments received either by cheque or cash. Receipts will be issued using a standard UDC receipt form by the UDC Office and commercial sections of UDC. The following must be adhered to:

- 6.10 Details of payments such as, amount of payment, date, name of client, the account number to be credited.
- 6.20 Payments receipted by UDC Commercial Units must be submitted to the UDC Accountant, who will recheck total receipts against actual money received either in cash or cheque. These payments will be credited into the appropriate Clearing Accounts.
- 6.30 NAL, IFTA and Rainforest Habitat shall maintain their own receipt books, which will be audited by the UDC Accountant on a monthly basis.

A7.00 Posting of receipts

Except for NAL, IFTA and RFH, all posting (crediting) to appropriate accounts will be undertaken by the UDC Accountant once a week. The following must be adhered to:

- 7.10 Payments received from Consultancy and Short Courses which are receipted by the UDC Office will automatically attract the following distributions in order of transaction:
- 7.20 3 per cent Sales Tax to be deducted from total invoice.
- 7.21 UDC 25 per cent share to be deducted based on the Approval Form or based on total invoice after 3 per cent Sales Tax.

- 7.22 UDC handling charge to be deducted based on the Approval Form.
- 7.23 The Balance of Income after consideration under Clause A7.20, A7.21 and A7.22 is to be credited to the Project Account.
- 7.30 UDC Commercial Units will submit to the UDC Office once a month, a summary of Total Income (Sales) in order to initiate the following:
- 7.31 3 per cent Sales Tax to be deducted from the respective Clearing Accounts.
- 7.32 10 per cent UDC share to be deducted from the respective Clearing Account.
- 7.40 NAL and IFTA will forward a cheque payment to the UDC Office under Clause A7.31 and A7.32.
- A8.00 Posting of Expenses**
- Posting of Expenses will be debited to the appropriate accounts based on the Actual Cheque paid and the Cheque Voucher raised by the UDC Office. The following must be adhered to:
- 8.10 Purchase Orders raised against a particular account will be noted separately and not debited against the account since the final purchase price may vary.
- 8.20 The UDC Accountant will post expenses to the appropriate accounts once a week.

A9.00 Statement of accounts

Financial statements of Trust Accounts and Project Accounts will be issued on a quarterly basis by the UDC Office. However, upon request, a statement will be issued within one (1) day to the requesting officer or the department.

Section B Management policies and procedures

B1.00 Consultancy approval

All contract officers of the university by their employment conditions with the university and as required by the Department of Personnel Management General Order No. 15, prohibit officers from engaging in any form of consultancy work or engaging in any form of business activities. As a result of this General Order and for other purposes, the university, by approval of the state, allows UDC for contract officers of the university to engage in consultancy work legally. The following must be adhered to:

- 1.10 It is therefore very important that university staff wishing to engage in consultancy work and short course activities file with UDC using the appropriate *Approval Form*.
- 1.20 Filing the 'Approval Form' is crucial for insurance cover and so that the university will recognize the consultancy work as approved duty other than teaching, research and other departmental work. Failure to observe this may result in staff discipline by the Registrar.
- 1.30 Approval Forms must be filed by the Principal Consultant, giving details of the projects etc. All cost estimates and distribution of income must be indicated on the form. Staff to be engaged must be listed.

- 1.40 The same Approval Form must be used if staff are undertaking research work through the UDC Office.
- 1.50 Where a staff member wishes to investigate possible consultancy work immediately and the Approval Form could delay the investigation, the staff member must formally write and inform the UDC Executive Manager, copied to the Head of Department and the Vice-Chancellor.
- 1.60 Approval Forms for Heads of Department will be signed by the Registrar and the Vice-Chancellor.
- 1.70 Approval by Heads of Department is an indication to UDC that the particular staff member is available to undertake such work.
- 1.80 Where an approval has not been granted, the concerned staff member may make formal presentation to Pro VC Academic with the Head of Department and the Executive Manager in attendance to reconsider the application.

B2.00 Transfer of funds

Transfer of funds can be initiated by the Principal Consultant or by the UDC Office upon request. Transfer of funds will be processed using the approved UDC Transfer of Funds form, which are numbered for auditing purposes. The following must be adhered to:

- 2.10 All requests for transferring funds by memo or other means will not be processed and UDC will return such documents to the requesting officer. Only completed Transfer of Fund forms will be processed by the UDC Accountant.

2.20 Transfers of Funds are normally of two types: (1) Internal Transfers of Funds for payment of services or for other purposes, (2) Transfer of Funds after completion of consultancy work normally regarded as 'Distribution of Profits'.

2.30 Requests to initiate Transfer of Funds ('Distribution of Profits') will normally take place after the completion of the project and all project expenses are accounted for. However the following may be considered.

2.31 Interim Distribution of Profits where the project is large in terms of fees and extends over at least three months.

2.32 Distribution of Profits with an estimated sum retained in the project account to cover incoming expenses. After payment of all expenses, the balance in the project is further distributed to the appropriate consultants and the project account closed.

2.40 Internal Transfers of Funds for payment of services or for other purposes implemented by the UDC Accountant, will require forwarding a copy of the transaction to the concerned department or person to notify and confirm that such transaction has taken place.

B3.00 Project Number and account Number

Each approved Consultancy, Short Course and Research will be assigned a Project Number and an Account Number by the UDC Office. The following must be adhered to:

3.10 All transactions in connection with the said project must have their Account Number and Project Number quoted.

- 3.20 All Trust Accounts and Project Accounts will be assigned only one set of five numbers into which income and expenses will be recorded.

B4.00 New, and closure of, trust accounts

The following must be adhered to:

- 4.10 A new Trust Account will be created for any new staff member joining the university upon request by such an officer. At the time of issue of the trust account, UDC rules and regulations governing trust accounts and other appropriate procedures will be issued.
- 4.20 Any staff member leaving the employment of the university permanently must advise the UDC Accountant at least 14 days in advance. This will allow proper audit of Trust Account and Project Accounts to facilitate closure of accounts prior to signing of the university Clearance Form.
- 4.30 The UDC Executive Manager will sign the university Clearance Form after ensuring that the consultant does not owe money to the UDC and the internal Revenue Section.
- 4.40 Where UDC owes money to the departing staff member, it must repay the overdrawn balance in full before the Clearance Form can be signed.
- 4.50 Where UDC owes money to the departing staff member, UDC will pay out the balance owing to the departing staff member if point 4.20 is complied with, otherwise a bank draft will be forwarded to an address advised by the departing staff, 14 days later.

4.60 The final pay-out to close the account will attract 35 per cent income tax.

4.70 Where an officer is permanently leaving the university he or she will not be eligible to claim conference or workshop expenses which will coincide with departure from the university, both locally and internationally.

B5.00 Operation of Personal Trust Accounts

The following guidelines are approved by the UDC Board, under which operation of Personal Trust Accounts will be administered. All staff undertaking consultancy work through UDC, by his or her consent to undertake such work will deem to have acceptance of the following:

5.10 Personal withdrawals

5.11 Any consultant wishing to make a personal withdrawal from his or her Trust Account can do so (depending on funds available) by filing a Payroll Requisition Form with the UDC Office. Telephone requests or other written requests will not be accepted. The following must be adhered to:

5.12 Payroll Requisitions will be processed through the university payroll system, taking into account income tax. Therefore requests from UDC must consist of a gross amount.

5.13 The Payroll Requisitions Form (standard form available from UDC) must be lodged with the UDC Accountant by Monday afternoon in order to be processed and forwarded to the University Salaries Section for payment for the coming pay period.

- 5.14 Cash withdrawals for personal reasons will not be accepted unless on written compassionate grounds. This withdrawal will attract 35 per cent income tax.
- 5.20 Duty travel
- 5.21 Per diem for UDC official duty travel related to conferences, workshop research, or project site visits etc. shall be approved by the Head of Department using a UDC Staff Expense Claim Form and a Cheque Requisition Form. These two forms must be submitted to the UDC Accountant for processing.
- 5.22 Cash Advance for UDC official duty travel related to conferences, workshops, research, or project site visits etc. shall be approved by the Head of Department, using a Cheque Requisition Form.
- 5.23 This form must be submitted to the UDC Accountant for processing. Upon return from duty travel, the Cash Advance must be acquitted using the UDC Staff Expense Claim Form approved by the Head of Department.
- 5.30 Purchase of equipment and supplies
- The Funds from Trust Account can be used for the purchase of items which are directly related to teaching, research and professional practice including consultancy work. The following items are approved for purchase through the Trust Account.
- (a) Computer hardware and software including associated accessories such as carrying case, cables, ink cartridges, computer printing paper and cleaning items.
- (b) Photographic cameras including extra lens, carrying case and cleaning accessories.

- (c) Textbooks, magazines and articles which are related to teaching, research and professional practice.
- (d) Office furniture such as chair, table, blackboard.
- (e) Cost of repairs and upgrading for items (a) and (b).
- (f) Purchase of photographic film, print film processing, slide film processing.
- (g) Drafting tables, pens, ink, stationery items.
- (h) Entertainment of clients directly related to consultancy work, will require project to be quoted. (i) Purchase of airline ticket, car hire, accommodation which are directly related to teaching, research and professional development.
- (j) Payment of professional membership fees, examination fees, registration fees to conferences and workshops.
- (k) Research costs including cost to develop prototype samples, testing costs, publication etc.

5.40 Tax on purchase of equipment

- 5.41 Where equipment has been purchased from cash withdrawal under Clause 5.10 involving 35 per cent income tax, such equipment is 100 per cent owned by the consultant. However, where equipment has been purchased under Clause 5.30 without the 35 per cent income tax consideration, such equipment is jointly owned by UDC on the understanding that such equipment is to be used for teaching, research and consulting work during the duration of the officer's employment with the university.

The concept will be to depreciate the equipment according to IRSS Schedule over a period of time such that eventually the equipment is written off. Thereafter the equipment is

100 per cent owned by the officer. An example is computers. Currently the depreciation rate is 30 per cent per annum. This will mean that after three years the computer is virtually written off, thereby attracting no income tax.

- 5.42 UDC will employ the (IRS) Diminishing Value Method to determine current value of equipment for the purposes of determining income tax due.
- 5.43 Where an officer leaves the employment of the university, all equipment purchased through the trust account under Clause B5.30 will be considered for appropriate income tax.
- 5.44 The following equipment will be subject to Clause B5.42:
 - (a) Computer hardware and software including printers, associated accessories such as carrying case, cables and external hard drive.
 - (b) Photographic cameras including extra lens and carrying case.
 - (c) Textbooks which are related to teaching, research and professional practice.
 - (d) Office furniture such as chair, table, blackboard.
- 5.50 Back-charging of equipment and facilities
- 5.51 Any consultant who intends to charge a project for the use of any equipment purchased through UDC will not have it considered as a separate cost item. Consultants may build this cost into their consultancy fee or have it built into the hourly charge-out rate. The only exception will be the hire of a personal car. In this case, a consultant shall use the university's approved charge-out rates.

- 5.52 Academic departments are currently being awarded 10 per cent from consultancy and short-course earnings to compensate for the use of departmental facilities. Any other costs to be charged over the 10 per cent share shall be discussed with the UDC Executive Manager.
- 5.60 Donation
- 5.61 Funds held in a Trust Account may be used for legitimate donation upon written request by the requesting officer. Request for donation must be accompanied by an official letter from the organization requesting such assistance.
- 5.62 Donations will only be made to registered non-profit organizations in Papua New Guinea. Other non-registered groups such as village community groups in Papua New Guinea will only be considered after appropriate documentation and an interview has been held with the UDC Executive Manager.
- 5.63 Donation to the university Academic Department to support teaching, research and student activities can be made through transfer of funds.
- 5.70 Transfer of funds will be implemented under Clause B2.00.
- 5.71 Consultants may transfer funds to another trust account such as Research and Development. For such transfers, the UDC Accountant will implement upon proper filing of the Transfer of Funds form.
- 5.80 Heads of Department will obtain the Vice-Chancellor's approval for transactions under Clause B5.10, Clause B5.20, Clause B5.30, Clause B5.60 and Clause B5.50.

B6.00 Operation of Department Trust Accounts

6.10 Duty travel

6.11 The Departmental Trust Account can be used for duty travel related to conferences, workshops, research, or project site visits etc. as approved by the Head of Department using the UDC Staff Expense Claim Form and a Cheque Requisition Form. These two forms must be submitted to the UDC Accountant for processing.

6.20 Purchase of equipment and other services

6.21 Funds from the Trust Account can be used for the purchase of items which are directly related to teaching, research and professional practice including consultancy work. Whilst UDC will not prevent departmental purchases, as long as funds are available, the UDC Board trusts that such purposes will be in the best interest of each individual department.

6.30 Donation

6.31 Funds held in the Trust Account may be used for legitimate donation upon written request by the requesting department. Request for a donation must be accompanied by an official letter from the organization requesting such assistance.

6.32 Donations will only be made to registered non-profit organizations in Papua New Guinea. Other non-registered groups such as village community groups in Papua New Guinea will only be considered after appropriate documentation and interview have been made with the UDC Executive Manager.

6.33 Donation to another university academic department to support teaching, research and student activities can be made through transfer of funds.

6.40 Transfer of funds will be implemented under Clause B2.00.

B7.00 Advertising

7.10 Consistent with university Guidelines on advertising, UDC will adopt the following as a matter of policy:

7.11 All advertising for and on behalf of UDC Pty Ltd will use the UDC logo and address followed by the department, section or consultant requesting the advertisement with details. Refer to Advertising Sample.

7.12 All UDC commercial Units such as MDC, NAL, IFTA, CECU, ESU, may use their own logo in advertising; however the name UDC Pty Ltd must be used in the heading of the advertisement and include the UDC office address as an alternative.

7.13 Generally, all Yellow Pages advertisements will be arranged and paid for by the UDC Office, including Business Directory advertisement.

7.14 All other announcements for Short Courses, Project Tenders, Expression of Interest etc., will be charged for and paid against each particular project. These announcements can be through the local newspaper, local radio station and local TV advertisement. All UDC commercial units will pay for their advertising cost except under Clause B7.13.

B8.00 Preparation of tenders/quotations/contracts

- 8.10 Whilst the responsibility of detailed preparation for a project proposal of tendering for consulting services or contract agreement lies with the principal consultant, care must be taken to phrase such documents, that UDC will efficiently deliver the project and be financially feasible. Where appropriate, the UDC Executive Manager or UDC legal services should be consulted to ensure fairness in such documents is maintained to protect the interests of UDC and the university.
- 8.20 For consultancy projects, Heads of UDC commercial units and principal consultants must consult the Executive Manager to discuss and determine the project costing and its possible implementation.
- 8.30 Contract agreements for consultancy work must be prepared in consultation with the Executive Manager. UDC will sign contracts on behalf of the consultant and therefore it is very important that the Executive Manager is informed at the outset of every major consulting project.
- 8.40 UDC has standard pro-forms for tender submission and contract setout. Consultants are advised to consult with the UDC Office.

B9.00 Copies of letters/memorandums/projects

- 9.10 All letters or memos bearing the UDC letterhead must be copied to the UDC Executive Manager.
- 9.20 All letters or memos where UDC is mentioned must be copied to the UDC Executive Manager.

- 9.30 One copy of all consultancy projects, including research projects done through UDC, must be submitted to the Executive Manager.

B10.00 Warranty

- 10.10 All goods and equipment supplied by UDC through its commercial units will be subject to warranty as specified by each unit at the time of sale of such good.
- 10.20 The warranty period will cover cost of freight and replacement of defective parts under normal use. Commercial units who provide warranty on sale of goods will allow at least 5 per cent surcharge as warranty at the time of sale.

B11.00 Ownership of reports/patents

- 11.10 All research work of any sort whatsoever developed by UDC's consultants shall be jointly owned by UDC, the Consultant and the Client where appropriate.
- 11.20 Principal consultants/researchers shall submit to UDC a copy of such reports. Permission to use any part of such reports shall be sought through the UDC Office to obtain permission from clients.
- 11.30 Policy on Inventions shall be consistent with university standing rules.

B12.00 Professional fees and rates

Professional charge-out rates for consultancy work other than short courses can be based on the following:

- 12.10 By using current approved fee scale of each professional body as a minimum.
- 12.20 By using a daily rate of K400 - K600 per day as minimum.
- 12.30 By using the following minimum hourly rates:
- | | |
|--|--------------------|
| 12.31 Principal Consultant | K75 - K90 per hour |
| 12.32 Assistant Consultant | K50 - K65 per hour |
| 12.33 Technical Officers
Technicians/Draughtsman/Laboratory Assistant | K15 - K20 per hour |
| 12.34 Secretary/Typist/Admin. Officer | K8 - K12 per hour |
| 12.35 General Helper/Labourer | K5 - K8 per hour |
- 12.40 Fees for undertaking short-course work shall be determined on a case-by-case basis. However, care must be taken to ensure that fees charged are competitive and consistent with other similar courses.
- 12.50 In determining fees, the following guidelines must be noted:
- 12.51 Rates are inclusive of 65 per cent to consultant, 25 per cent to UDC and 10 per cent to department.
- 12.52 Use these hourly rates as a guide to charge a project where appropriate.
- 12.53 Consultant's proposed hourly rates must be agreed upon with the client before undertaking work.
- 12.54 Hourly rates do not include direct expenses. These would need to be charged as extra, with UDC's 10 per cent handling charge to be allowed.

12.55 Total invoice to clients must include Sales Tax of 3 per cent.

12.56 Hourly rates will be reviewed and adjusted as and when required.

B13.00 Participation of academic staff in consultancy or short course

13.10 UDC encourages all staff in the various academic departments to participate where appropriate in undertaking consultancy and short-course activities.

13.20 Academic departments must ensure an equal opportunity for all staff to participate.

13.30 Where consultancy work or a short course have been obtained by an individual's own effort or reputation, then such work can be solely undertaken by such a person unless he or she invites other consultants to participate.

13.40 Where consultancy work or a short course have been obtained through a department, then such work must be tabled at the department where, if desired, a committee can appoint a staff member or a team to undertake such work based on qualifications and experience.

13.50 UDC will insist that departments monitor the types of consultancies and short courses undertaken to ensure that such activities are consistent with departmental aims and goals.

B14.00 Donations/financial assistance/sponsorship

14.10 Donations by consultants will be administered under Clause B5.60.

- 14.20 Donations by departments will be administered under Clause B6.30.
- 14.30 The Policy on donations and requests for financial assistance to be made by UDC Commercial Units must not exceed the approved budget allocation for a given year.
- 14.40 The UDC Office will contribute a minimum of K1,000 per annum to the Vice-Chancellor's special vote, from which the funds are dispersed at the discretion of the VC's Office.
- 14.50 UDC will provide sponsorship to student groups, staff associations or other groups upon approval by the Executive Manager in consultation with the Board.

B15.00 Insurance

Consistent with good business practice, UDC will maintain the following insurances:

- 15.10 Workers Compensation insurance as required by Labour Department law, or full-time employees of UDC, paid for by each commercial unit based on the number of employees.
- 15.20 Comprehensive insurance for all UDC vehicles, paid for by each commercial unit based on the number of vehicles.
- 15.30 Fire insurance for all UDC properties, paid for by each commercial unit based on properties owned.
- 15.40 General Policy insurance up to the value of K25,000 to cover equipment while being used for UDC work. This will include university equipment being used for consulting work. Principal consultants must notify UDC if the value of

equipment being used outside of the university campus exceeds K25,000, for which additional cover must be taken.

- 15.50 Professional Indemnity insurance for all consulting work and services. This insurance will cover all managers and senior staff of UDC commercial units. The policy will also cover university staff who have registered with the UDC Office. All university staff not registered with UDC will be covered by this insurance.

B16.00 Code of ethics

- 16.10 Employees of UDC and staff as consultants from the university shall at all times be responsible and held accountable for any dealings for UDC at all times. Whilst reasonable care and a prudent approach is to be taken by such officers, UDC expects that professional judgement, based on standard practice and statutory rules and regulations, is to be taken into consideration.

- 16.20 Any university staff member under Clause B26.10 found to be in breach of good business ethics will be referred to the university Legal Officer and the Registrar for appropriate action.

- 16.30 Any UDC employee under Clause B16.10 found to be in breach of good business practice will be referred to the Executive Manager or the Board, where required, for appropriate action.

B17.00 Profits from departmental commercial units

- 17.10 Profits generated by university units such as the AV Unit, Civil Engineering Commercial Unit and Electronic Services Unit will be dealt with in the following manner.

17.20 UDC will declare an agreed profit and the sum will be transferred to its income account.

17.30 Balance of the profits will be retained by the unit and the sum reported to the Bursar.

17.40 University employees in these units will not automatically receive bonus payouts. Any bonus payouts must be recommended by the Head of Department and forwarded to the Registrar's Office for approval.

B18.00 Limit of consultancy work by university employees

18.10 Consistent with university employment contract conditions, and to ensure that academic staff have teaching and research as a priority, the following policy must be complied with.

18.20 All university staff acting as consultants for UDC will be limited in the amount of consultancy work. Consultants will not be permitted to earn more than 50 per cent of their base salary in one calendar year. Staff in breach of this policy will be referred to the Registrar.

18.30 Heads of Department may request the UDC Accountant to provide details of earnings of a particular staff member to assist in monitoring his or her consultancy activities.

B19.00 Part-time employment of Unitech employees

19.10 The employment of university employees on the UDC payroll will not be permitted unless the person has resigned from the university.

19.20 It will not be permitted for university employees on leave to seek part-time employment on the UDC payroll.

- 19.30 University employees on leave can only be hired by UDC as consultants. Payment for the consultant's services will be made through payroll requisition. Refer to Clause A4.00.

B20.00 Departmental equipment purchased through UDC

- 20.10 Heads of Department may purchase equipment under Clause B6.21.
- 20.20 The equipment is owned by the department and will not be listed as assets of UDC under the accrual accounting system.
- 20.30 A list of equipment purchased may be disclosed to the Bursar if required.

B21.00 Ownership of project equipment

- 21.10 Equipment purchased through project funds will be treated in the following manner after the completion of the project.
- 21.20 Equipment may remain in the department for future use if agreed by principal consultants involved in the project.
- 21.30 An item of equipment may be sold if agreed by principal consultants. The proceeds will be shared: 65 per cent to consultants, 10 per cent to department, and 25 per cent to UDC.

B22.00 External consultant fees

- 22.10 Consistent with the policy directive on distribution of profits (UDC Memo 02/12/96) all consultants, regardless of whether they are university staff or non-university staff, will be regarded as consultants by UDC.

- 22.20 As such, the UDC share from consultants' earnings will be 25 per cent, with 10 per cent to the department.

B23.00 Donated funds

- 23.10 Consistent with the directive on donated funds by the Bursar (Memo 14/08/96), Heads of Department are to note the implication of having donated funds held through UDC.
- 23.20 Donated funds held by UDC are subject to a 10 per cent handling charge.

Section C Policies for UDC employees

C1.00 Appointments and salary increments

- 1.10 The Executive Manager, in consultation with the manager of a UDC Commercial Unit will determine the initial salary level of all General and Casual staff, Administration/Clerical and Accounting staff, and Laboratory Technical staff. All performance increments and promotions will be approved by the Executive Manager after consultation with the appropriate UDC Commercial Unit Manager, including the following:
- 1.20 The Board of Directors, in consultation with the Executive Manager, will determine the initial salary level of all Management staff. All performance increments and promotions will be approved by the Board of Directors, after consultation with the Executive Manager.
- 1.30 The Board of Directors will determine the initial salary level of the Executive Manager. All performance increments and promotions will be approved by the Board of Directors, after consultation with the Vice-Chancellor.

- 1.40 Annual increments will be based on performance, and will be awarded in accordance with the approved salary scales. There will be no automatic increments. Adjustment to the scales to reflect CPI increases will be approved by the Board of Directors in consultation with the Executive Manager.

C2.00 Code of ethics

- 2.10 Refer to Clause B16.10 and Sub-Clause B16.30.

C3.00 Bonus policy for UDC employees

- 3.10 The practice of paying a bonus to full-time employees of UDC has been in existence for some time, without proper UDC Board approval. This practice has ceased and more appropriate bonus concepts will be considered in line with the Companies Act. All profits will be declared to the UDC Board annually and only then will the Board decide how to dispense with such profits.

C4.00 Consultancy work by UDC employees

- 4.10 Full-time employees of UDC, including all contract officers, will not be permitted to undertake consultancy work. All work undertaken by staff in full commercialized UDC units will be treated as part of employment duty. Any staff of all categories found to be in breach of this policy may face dismissal or other appropriate action recommended by the Executive Manager.

**THE MANAGEMENT OF UNIVERSITY-INDUSTRY RELATIONS:
EXPERIENCES OF BOGAZIÇI UNIVERSITY, TURKEY**

by

Okyay Kaynak

THE MANAGEMENT OF UNIVERSITY-INDUSTRY RELATIONS: EXPERIENCES OF BOGAZIÇI UNIVERSITY, TURKEY

1. Abstract

This study reports the experiences gained at Bogaziçi University in the management and the advancement of university-industry relations. First, the contextual factors are summarized by presenting a brief history of the Turkish economy and its present characteristics. The programmes that are presently implemented by the government for facilitating the development of relations between universities and industry are described and their apparent achievements to date are presented. The attention is then turned to universities in Turkey and the external context of the Bogaziçi University is presented. The current status of higher education in Turkey and the demographic, social and financial pressures on higher education institutions are briefly described.

Next, the characteristics of Bogaziçi University, namely its history, academic and administrative structure, student intake, strengths and weaknesses, are presented. The study then continues with a description of the past and the current status of university-industry relations and the internal and external driving forces behind the development of linkages. The ongoing activities are outlined, together with the levels of income generated per year from various categories of activities.

The study continues with a discussion on the management of university-industry relations, the instruments for its advancement, the interfaces both with industry and the government. The organizational frameworks and the incentive structures are outlined and the issues of confidentiality and the protection of intellectual rights are touched upon.

This study also points out some recommendations for the future development of relations with the private sector. In April 1997, a group of 25 European university rectors and vice-rectors was hosted by Bogaziçi University in connection with the University Management Programme of the Association of European Universities. During the visit, they were invited to undertake a review of the university's policies and practice in terms of relations with the private sector. This study concludes with a narration of their observations and recommendations for the strengthening of university-industry relations at Bogaziçi University.

2. Contextual factors

2.1 General features of the economy and industry

Since the establishment of the Republic of Turkey in 1923, the Turkish economy has grown through a number of phases, first liberal, then mainly state oriented and protectionist, then hybrid. The principles of today's industrial policies were set in 1980, by the abolishment of import substitution and the adoption of export-oriented industrialization policies. A number of measures were taken to revamp conditions for entry, operations and exit for both national and international business. Bureaucratic barriers were dismantled and procedures were streamlined based on a thorough deregulation effort. These measures have borne fruit and the Turkish economy has shown a very dynamic (albeit irregular) performance, growing at an annual average rate of 5 per cent since 1981.

A milestone for Turkish industry is the customs union with the European Union (EU) that came into effect on 1 January 1996, guaranteeing the free circulation of industrial goods and processed agricultural products. The customs union foresees abolishing customs duties, prohibiting quantitative restrictions such as quotas, and the

harmonization of Turkey's commercial and competitive policies, including intellectual property laws, with those of the European Union. In effect, it extends most of the EU's trade and competition rules to the Turkish economy, a condition under which some economists feared that small and medium-scale enterprises in the manufacturing sector would not be able to survive. The past two years have shown that these fears were groundless. Although the imports have increased (to over US\$40 million in 1997) at a greater rate than the exports (nearing US\$25 million), the overall picture is positive. An appreciable amount of foreign trade takes place through what is called 'suitcase tourism' as an unrecorded export. The volume of this trade was estimated to be around US\$9 million in 1996 and US\$6 million in 1997.

Over the 75 years of the republic, the agricultural characteristics of the Turkish economy have significantly changed. A comparison of the early eighties and recent years indicates that their weight in GDP has reversed; in 1980 and 1981 agriculture accounted for about 25 per cent of the GDP in current prices and industry for about 20 per cent. In 1997, the corresponding figures were 25 per cent for industry (its breakdown being 21.3 per cent for manufacturing, 2.5 per cent for energy and 1.2 per cent for mining and quarrying) and 15 per cent for agriculture. The contributions of the other main sectors in 1997 were: trade, 20 per cent; transportation and communication, 13.9 per cent; construction, 6 per cent; and financial institutions, 5.3 per cent.

The changes described in the above paragraph are reflected in the composition of exports too. As can be seen from *Table I*, in the past two years, manufacturing has accounted for 87-88 per cent of all exports.

Table 1. Export figures in the manufacturing sector for 1996 and 1997

Sector	1996		1997	
	Total in Million USD	% of total exports	Total in Million USD	% of total exports
Manufacturing	20,237.1	87.1	23,115.9	88.1
Food products and beverages	2,193.8	9.4	2,454.3	9.4
Tobacco products	100.2	0.4	123.8	0.5
Textiles	4,564.7	19.7	5,354.4	20.4
Wearing apparel	4,083.4	17.6	4,539.3	17.3
Luggage, saddlery and footwear	220.9	1.0	299.2	1.1
Products of wood and cork	68.8	0.3	75.1	0.3
Paper and paper products	125.7	0.5	154.2	0.6
Printing and publishing	47.7	0.2	40.1	0.2
Coke, petroleum products and nuclear fuel	259.2	1.1	179.1	0.7
Chemicals and chemical products	1,131.9	4.9	1,362.7	5.2
Rubber and plastic products	510.2	2.2	621.2	2.4
Other non-metallic minerals	780.1	3.4	931.2	3.5
Manufacture of basic metals	2,258.2	9.7	2,611.8	10.0
Manufacture of fabricated metal products (excluding machinery)	401.5	1.7	454.4	1.7
Manufacture of machinery and equipment	854.5	3.7	1,035.6	3.9
Office, accounting and computing machinery	21.3	0.1	28.8	0.1
Electrical machinery and apparatus	772.0	3.3	743.6	2.8
Communication and apparatus	316.5	1.4	469.4	1.8
Medical, precision and optical instruments, watches	56.6	0.2	61.0	0.2
Motor vehicles and trailers	977.0	4.2	829.1	3.2
Other transport	155.3	0.7	353.9	1.3
Furniture	249.2	1.1	300.0	1.1
Recycling	88.3	0.4	93.8	0.4

2.2 The structural characteristics of enterprises

An analysis of the enterprises in Turkey (see Table 2) shows that small and medium-scale enterprises occupy a special position both in the social and the economic frameworks of Turkey. If one looks at the manufacturing industry in particular:

- 99.55 per cent of all enterprises in the manufacturing industry are SMEs;
- SMEs account for 66.1 per cent of employment;
- SMEs' portion in total value-added created is 27.3 per cent;
- the average number of employed in small enterprises (94.4 per cent of the total) is very small, being less than three;
- SMEs generally do not use or have access to credits, their share in bank loans is around 4 per cent;
- their share in exports is 8 per cent;
- they generally use low technology;
- they generally lack skilled personnel;
- they need support to increase their competitiveness.

Table 2. The distribution of enterprise, employment and value-added by size of firm in the manufacturing industry in 1992

Categories	Enterprises		Employment		Value-added
	Number	%	Number	%	%
Number of workers					
1-9	186,574	94.4	545,809	35.6	7.7
10-49	7,972	4.0	175,660	11.0	5.6
Small-sized industry	194,546	98.4	721,469	47.1	14.1
50-99	1,405	0.7	97,356	6.4	5.4
100-199	842	0.4	116,319	7.6	7.8
Medium-sized industry	2,247	1.1	213,676	14.0	13.2
SME (Small + Medium)	196,793	99.5	935,144	61.1	27.3
200+ (Large sized)	982	0.5	595,601	38.9	72.7
Total	197,775	100	1,530,745	100	100

The characteristics of Turkish SMEs stated above make it, in general, difficult for the establishment of university-SME co-operation. Only a limited number of SMEs have the necessary educational, technological and psychological background for effective collaboration. Recently a survey was carried out among some selected SMEs around the Istanbul metropolis where many of the leading-edge industrial companies of Turkey are located (Karahoca et al., 1996). The survey had the objective of analyzing the nature of R&D activities and of developing recommendations for R&D programmes and consultancy services. The target group was therefore carefully selected, namely those SMEs which were doing, or would like to do, product development. Finally, a total of 78 SMEs were interviewed, 8 of them being resident in KOSGEB (Small and Medium Industry Development Organization of Turkey, Ministry of Industry) technology development centres. The survey consisted of four parts, probing into the general structure of the SME, its managerial and infrastructural characteristics, the R&D concept and existing R&D activities, and new product development policies. Some of the important conclusions of the survey are as follows:

- generally technology is imported;
- any technological innovation is customer driven;
- R&D concepts are not fully understood;
- some developed prototypes fall within the high-tech definition;
- there are, in general, difficulties in finding funding for putting prototypes into pilot-scale manufacture;
- SMEs in the computer hardware sector depend thoroughly on imported technology;
- government and large-scale enterprises do little in promoting technology transfer into SMEs;
- almost every SME interviewed would like to start R&D activities but does not know the means by which to do so;
- R&D collaboration between large firms and their subsidiaries or parts suppliers does not exist;
- six out of ten large companies are public.

In the paragraphs above, the attention has been concentrated on SMEs. With regard to the large enterprises, those with more than 1,000 employees make up only 0.07 per cent of all enterprises, but they create 34 per cent of the value added. The share of public enterprises is 8 per cent in terms of numbers and 27.55 per cent in terms of the value-added created. Six out of ten of the largest companies are public.

Turkish industry has another important characteristic with regard to its geographic concentration. The majority of companies are concentrated around Istanbul and Kocaeli in the Marmara region, some are around Ankara and some around Izmir and Adana. This facilitates some interaction between companies and eases reaching-out, but brings about a tremendous load on the infrastructure and the environment.

2.3 Research and development incentives

R&D activities in Turkey are at present relatively weak, as illustrated by the following points (Arikan, 1996):

- only 0.5 per cent of GNP is set aside for R&D, as compared to 2 per cent in Europe, 2.7 per cent in USA and 2.8 per cent in Japan;
- only 8 per 10,000 of the active labour force are engaged in R&D activities as compared to 93 in Europe and 126 in Japan;
- innovation financing is not well developed;
- there exists very little university-industry interaction.

It is only in recent years that R&D activities of industrial companies have been encouraged with some incentives. Until June 1995, the only incentive for R&D activities was a restricted tax deferment, which came into effect only in 1989. In 1995, two new measures for R&D promotion were put into effect: tax incentives for R&D investments, and grants for R&D projects (Arikan, 1996). A special unit of TUBITAK (Scientific and Technical Research Council of Turkey) manages all three incentive programmes.

- *Corporate tax deferment for R&D expenditure:* The R&D expenditure of a corporation in a calendar year is the base for tax deferment. It is distributed over three years but cannot exceed 20 per cent of the tax to be paid that year.
- *Tax incentives for R&D investments:* To encourage both foreign and domestic investors, investment incentives have always been generous in Turkey. R&D investments are announced as priority-area investments and 100 per cent of the value of investment can be written off against tax in the year that they are purchased.
- *Grants to industrial R&D projects:* Industrial R&D projects are supported by public funds to the tune of 20 per cent to 50 per cent

of the R&D expenditure, depending on the R&D performance of the company over the past years. Project-related hardware and software, consumables, materials, travel and personnel expenditure are accepted as legitimate expenditure. Additional grants are possible if a patent is obtained (10 per cent), if personnel with doctorate degree are involved in the project (15 per cent), if the project is in the priority areas as specified by TUBITAK (20 per cent) and if part of the R&D is carried out in collaboration with universities, research institutes or at technoparks. In mid-1996, the total of the estimated costs of the projects being considered for grant was almost US\$140 million and the expected amount to be granted was US\$54 million.

2.4 Technology Development Foundation

The Technology Development Foundation (TDF/TTGV) is another establishment that promotes R&D activities in Turkey. It was founded by the joint efforts of the private and public sectors on 1 June 1991. The major source of its assets is the US\$43.3 million made available for its disposal through a Loan Agreement signed between the Republic of Turkey and the World Bank. In its organizational structure, there are currently 47 founders, 57 per cent of which are industrial companies; 20 per cent individuals; 13 per cent associations and similar organizations; and 10 per cent the public sector. Three out of the nine members of the Board of the TDF hold office by appointment: representatives of the Undersecretariat of the Treasury; the Small and Medium Industries Development Organization (KOSGEB); and the Scientific and Technical Research Council of Turkey (TUBITAK). The remaining six members are representatives of the private sector. Two major tasks are assigned to TDF (Web Site of Technology Development Foundation, see References):

- implementation of studies related to the competitiveness of Turkish industry in a changing international marketplace;

- provision through diverse financial instruments of seed capital for projects that have the potential for developing Turkey's technology infrastructure.

Presently, 36 per cent of the 134 supported projects are owned by enterprises with less than 25 employees, 28 per cent by enterprises with between 25-149 employees, 21 per cent by enterprises with between 150-999 employees, and 15 per cent by enterprises with more than 999 employees. Out of a total of US\$194 million committed for support and materials, technology-related projects take the largest portion (32 per cent), followed by machinery (20 per cent), informatics (19 per cent) and electrical and electrotechnology (14 per cent).

2.5 University-industry interaction and its growth as a result of the R&D incentives and research grants

University-industry relations have been traditionally weak in Turkey. This may be due to:

- a general disinterest on the part of the professor;
- different time horizons for research outputs: short and definite for industry, and long and flexible for the university;
- different goals in the activity; industry seeking practical exploitation, resolution of existing problems, increasing quality and productivity; the university seeking new knowledge, new theory and thoroughness;
- the considerations of confidentiality clashing with the desires of the university to publish and disseminate knowledge;
- lack of adequate equipment at the universities;
- unpleasant experiences of the past.

In addition to these negative views, the dominance of SMEs in the Turkish economy creates another obstacle towards the development of university-industry relations in Turkey.

In recent years, especially after the signing of the GATT Uruguay Round 'final document' and entry into customs union with the EU, large enterprises have started up their own R&D departments employing some Ph.D. holders. They have started to make sincere attempts to establish university-industry linkages, either by seeking consultancy or by contracting some of their research efforts.

A new dimension to the university-industry link has recently emerged. Large holdings have started establishing private universities through non-profit foundations associated with the holding. For example, both the Koc Holding and the Sabanci Holding have established universities. It is expected that universities of this kind will have very close linkages to their mother industrial enterprises. This might motivate public universities to also seek closer relations with industry.

Another new development is emerging as regards the new universities of rural towns where there is some industrial density. In a number of them, through the efforts of the dynamic university administrations, strong linkages have been established with the local industry chambers, the latter providing 'patronage' to the university in some ways. It is expected that this relation will soon reflect itself into local industry-university linkages on a project basis.

Also, the R&D incentive measures introduced in 1991 and the project grants of the Technology Development Foundation have had a positive impact in university-industry relations. Firstly, a number of enterprises, especially the small ones lacking experience in R&D project management, have felt the need to approach a university faculty for the formulation of their project in a project proposal form, for consultancy in its implementation, etc. Secondly, both TUBITAK and TTGV, who do not have enough personnel, started using the university faculty for the evaluation of the project proposals. This involved visits by the university

professors to the premises of the companies for discussions on the project, thereby creating a means of interaction. Once a project is accepted for a grant, a university professor is assigned by the TDF to monitor the project on its behalf. The physical contacts made in these ways have provided the basis for further possible collaboration.

3. Turkish higher education system

3.1 History (Web Site of the Turkish Council of Higher Education, see References)

After the creation of the Turkish Republic, a number of higher education institutions were established in Ankara. During the period 1955-57, four main universities of today, Ege University, Middle-East Technical University, Karadeniz Technical University and Atatürk University, were created. Another wave of university openings took place during 1973-81 by the creation of 10 new institutions in major towns of Anatolia.

With the new Constitution of 1981, some new provisions were made for higher education, academies were merged into universities, and some new ones were established, bringing the total up to 27 by the year 1982. Ten years later, in 1992, to keep up with demographic pressure and the growing manpower needs of the market economy, a new wave of universities came along, with the establishment of 21 new universities and 2 high-technology institutes. Meanwhile, in 1984, the first private 'foundation' university, Bilkent University, was established in Ankara. Since 1992, a number of new state and non-profit foundation universities have been set up. In 1998, there were 72 universities, 53 of which were state universities, two of which had English as the medium of instruction (Bogaziçi and Middle-East Technical) and one French (Galatasaray). In certain state universities, some programmes are carried out either wholly or partially in English and, to a lesser extent, in German. Some state universities require a one-year intensive preparatory English

course. With regard to the private universities, the medium instruction is in English in all 19 of them. However, five of the private universities have not yet started enrolling students.

What is stated above indicates a tremendous increase in the number of universities over the recent decade or so. The pressures behind this are analyzed in the following section. In the 74 years that have passed from the academic year 1923-24 to 1997-98 the following increases have taken place:

- the number of universities grew from 1 to 72;
- the number of student enrolments from 2,914 to 1, 322,345;
- the number of graduates from 321 to 165, 697;
- the number of academic staff from 307 to 55,444.

3.2 Administration and financing of the Turkish higher education system

The major component in the annual income of state universities is the funds appropriated through the annual state budget. It is negotiated jointly by the Higher Education Council, a national buffer organization in charge of defining and implementing higher education policy, and the university. In the case of the investment budget, negotiations are held with the State Planning Organization for final approval by the Parliament. The state budget allocation per full-time student fluctuates across the universities, and over the years, between US\$1,500-2,500.

In addition to the state allocation, each university has three additional sources of income:

- income from the services provided by the university, such as patient care in university hospitals, and contract research, collected in a revolving fund;

- student contributions as tuition fees (highly subsidized);
- research funds made up of a lump-sum grant from the state-provided budget.

The first item constitutes 25 per cent of the budget, on average. This percentage is much lower in universities that do not have a medical college like Bogaziçi. The student contributions also fluctuate, an average figure is 7 per cent of the income. It is used basically to subsidize meals and lodgings provided to the students. The third source of income constitutes about 3 per cent of the university budget and is used for supporting research projects and, to a limited extent, faculty participation in international conferences. All these additional sources of income are also subject to laws, rules and regulations similar to those concerning the state-provided budget. In contrast to the tight financial difficulties and the regulations that the state universities have to operate, the private universities enjoy full financial autonomy. Both student tuition fees and faculty salaries are at levels comparable to the USA standards. Additionally, they receive state subsidies up to 45 per cent of their annual budgets.

There is a recent surge in the establishment of private universities which is partially due to the great demand that is present. In 1997, 11,425 students were placed at these universities, accounting for 4.5 per cent of the total placements. Additionally, the Turkish Republic of Northern Cyprus is becoming an increasingly popular destination for higher education and, in 1997, 7,774 were placed at the five universities that exist in this republic.

According to the State Statistics Institute, there are 5,142,000 students at the age of higher education. The total number of students enrolled in a higher education programme is 1,322,345. Therefore, 25.5 per cent is presently enrolled in an institution of higher education.

4. Bogaziçi University

4.1 History

Bogaziçi University has a long history and heritage, dating back to 1863. It is the successor to Robert College, established by the American missionary and philanthropist Cyrus Hamlin. It has gone through many important transformations since then. Its missionary characteristics were the first to change as it took up the objective of catering to the children of groups of different nationalities, races, and religions in a multi-religious and multi-national empire. In 1912, the School of Engineering was founded, followed by the School of Administrative Sciences and the School of Arts and Sciences in the 1950s, thus firmly establishing itself as a prestigious institution of higher education. However, with the rising sentiments of the sixties against private institutions of higher education, the Board of Trustees in New York decided, in 1971, to turn over its Bebek campus to the Turkish Government, retaining the Arnavutköy campus (the campus of the American College for Girls) to cater for only high-school students. Bogaziçi University as a Turkish State university was thus created.

Since 1971, Bogaziçi University has had to go through a very rapid and painful expansion process. The number of students increased from 1,000 in 1971 to 3,000 in 1982 and to 10,000 in 1991, due to external pressures put on the university through the Higher Education Council. The numbers have now stabilized.

Such high rates of growth have put great stress on the existing infrastructure. The campus has had to expand outside of the borders of the old Robert College, into a densely populated region. The quick rate of construction and its density (the floor area has increased from 3,000 m² in 1982 to almost 20,000 m² in 1995) have resulted in a completely different nature of the campus. The university now has two different facets: the South Campus and the new North Campus. Additionally, there

exist four more campuses, the Hisar and Ucaksavar campuses, not far from the North and South campuses, the Kandilli Campus, where the Observatory is located, and the Saritepe Campus at the Black Sea coast of Kilyos (about 20 km away) where some further expansion of the university will take place in the future.

4.2 Some basic characteristics of Bogaziçi University (BU)

Despite the recent increases in student intake, the average Bogaziçi University student is still exceptionally good. In order to qualify for most BU programmes one has to be among the top 1 per cent of 1.4 million students taking the central entrance examination. It is therefore considered by students to be the most prestigious and highly preferred university in Turkey.

The university has 22 departments, grouped into four faculties: Arts and Sciences, Engineering, Economics and Administrative Sciences, and Education. Graduate-level education is provided by two Institutes, namely, Science and Engineering, and Social Sciences, with the support of these faculties. There are also four smaller, specialized institutes that offer graduate programmes: Biomedical Engineering, Environmental Sciences, Kandilli Observatory and Earthquake Research, and Atatürk Institute of Modern Turkish History.

The medium of instruction at the university is English and all new students have to take an English proficiency examination. A TOEFL score of 550 and 4.5 on the written component is accepted as proficiency. Those who do not pass the examination are required to study at the School of Foreign Languages.

Tables 3 to 6 give some statistical information regarding the students and the faculty. It can be seen that the ratio of students to full-time academic faculty members (excluding the English Prep School and the School of Applied Disciplines) is about 28. The number of full-time staff and administrative personnel is 826.

Table 3. Student enrolment for the 1996-1997 academic year

Undergraduate	Graduate	School of Applied Disciplines		School of Foreign Languages		Total
		2 years	4 years	Translation	Engl. Prep.	
6,293	1,288	529	79	164	118	9,534

Table 4. Number of students in undergraduate programmes (1996-1997)

Faculty of Engineering	Faculty of Arts and Sciences	Faculty of Econ. and Admin. Sciences	Faculty of Education	Total
1,604	2,143	1,714	832	6,293

Table 5. Number of students in graduate programmes (1996-1997)

Science and Engineering		Social Sciences		Specialized institutions		Total	
MS	Ph.D.	MS	Ph.D.	MS	Ph.D.	MS	Ph.D.
450	181	3,448	7	157	78	951	337

Table 6. Number of faculty members (as of December 1996)

Professor (Full, Associate, Assistant)	Instructor / Lecturer	On contract	Part time	Total
283	204	36	159	682

Table 7 shows the various sources of income of the university for the past five years. As can be seen, salaries take up a steady 50 to 55 per cent of the government-appropriated budget. On the other hand, tuition revenues have steadily increased and reached 15 per cent of the government appropriated budget in 1996. During the 1996-97 academic

year, the tuition fees ranged from US\$350 (for students in the Faculty of Engineering) to US\$130 (for students in the Faculty of Education).

The table indicates a steady decline in the government-appropriated budget since 1993. This is in line with the general trend in the country. During this period, the proportion of the budget for higher education compared to the total budget for education has decreased from 4.1 per cent to 3.1 per cent and the ratio in GDP from 0.9 per cent to 0.8 per cent.

Table 7. Budget trends (in US dollars)

	1992	1993	1994	1995	1996
Government appropriated budget	26,000,000	27,700,000	17,530,000	16,060,000	17,316,000
Salaries	14,200,000	13,800,000	8,750,000	8,780,000	9,150,000
Current expenditures	6,050,000	6,900,000	3,620,000	3,320,000	3,370,000
Infrastructure expenditures	5,750,000	7,000,000	5,160,000	3,960,000	4,796,000
Tuition revenues	620,000	982,000	793,000	2,088,000	2,964,000
Revolving Fund revenues	680,000	68,000	196,200	292,000	470,000
BU Foundation revenues	552,785	1,646,000	1,845,000	2,603,000	2,806,000

The research funds of the university, allocated by the government, have been supplemented by technological research projects and by the contributions of Bogaziçi University Foundation (BUVAK), as shown in *Table 8*.

Table 8. Research allocations (in US dollars)

	1992	1993	1994	1995	1996
Appropriation to Research Fund	800,000	678,000	436,000	400,000	542,000
Technological research projects	800,000	1,215,000	653,000	523,000	725,000
Research support by BUVAK	29,000	9,000	141,000	273,000	241,000

4.3 Bogaziçi University Culture

In the relations of Bogaziçi University with industrial enterprises, the key cultural characteristics of the Bogaziçi University play an important role. These are outlined below (Web Site of BU: European Rectors' Conference, see References):

Strengths

- qualified, well-educated group of faculty members;
- the image of BU is very strong – attracts best students in the country;
- instruction in English bolsters potentials in contract research and consultancy (a negative effect for continuing education);
- RC inheritance – strong social pressure for appreciation of quality;
- awareness of strategic vision.

Weaknesses

- very low salaries;
- small research volume;
- no tradition of institutional co-operation with private sector;
- RC inheritance-social club atmosphere, equality syndrome;
- 'We are No. 1' syndrome, leading to conservatism and often apathy.

5. Past and current status of university-industry relations at Bogaziçi University

5.1 Status prior to 1992

As has been explained in the previous chapters, Bogaziçi University went through a period during which external forces, rather than the internal ones, dictated how things developed. It started during the military regime of 1980-83, during which a centralization of higher education was initiated and the present Highest Education Council (HEC) was founded. During this period, university-industry linkages developed only to the extent of individual efforts of a limited number of faculties. The consultancy activities were limited mostly to spending a day or two a week at other public institutions such as Marmara Research Centre of TUBITAK, located at Gebze, not very far from the university, or at some small companies that a particular faculty might have private connections with. Little organized effort was there to market the potential of the university in terms of continuing education activities (in-house or public), research and technology transfer, consultancy and other. Nevertheless, during this period continuing education courses were started. At the Faculty of Engineering, a number of seminars on advanced engineering topics, mainly on industrial automation, were offered that involved hands-on training and which were very well received by both the public and the private sectors. A number of in-house seminars were also organized at various public and private enterprises.

During that period, the School for Advanced Vocational Studies (also called the 'Junior College') identified a niche in the market for computer training and offered short certificate courses periodically aimed at the general public, advertising them in the national newspapers. These were highly successful, not only because of the quality and the usefulness of the courses offered, but also because of the value placed by the public

on a certificate from Bogaziçi University. It generated an appreciable source of income for the university and to those involved in the courses through the Bogaziçi University Foundation, so much so that it set a model to other universities both in its technical content and its administration.

The driving force behind the activities described above was mainly the need to generate an extra income to supplement the poor salaries.

5.2 Activities during the past five years

About five years ago, a new administration of the university took over and provided a strong drive towards the strengthening of linkages with industry. It established a general framework for the fragmented continuing-education courses that had been organized, increased the consultancy activities, brought some standards to it in financial terms, increased technology transfer and increased joint research activities with industry. The objectives of pursuing relations with the private sector were spelled out as follows:

- generation of income;
- co-operating with industry to stimulate research;
- increasing the experience of its faculties in applied disciplines;
- transferring knowledge to society (as one of the major tasks of a university);
- strengthening its image as a leading university generating and disseminating knowledge;
- starting international collaboration within EU programmes such as Eureka;
- improving capabilities of departments or individuals through partnership (sharing of existing knowledge and facilities in the private sector; sharing 'cultures').

The administration of Bogaziçi University Foundation played a leading role in developing relations and orchestration of the efforts. Meetings were organized with industry on specific areas, diagnostic visits were paid to a number of establishments, continuing education courses offered by the university were published in the form of a book and distributed widely, etc. These efforts very quickly bore fruit and the income generated through the Foundation tripled in one year, from 1992 to 1993 (see Table 7), nearing US\$3 million in 1996.

For administrative reasons several committees were established to draw up guidelines for various activities. For example, the following policy statements were drawn up by Bogaziçi University Senate Subcommittee on Technology Transfer and approved by the Senate in November 1996.

- Choose high-tech issues for consultancy rather than routine tests or standard practices or projects.
- Emphasize technology development, expertise accumulation, together with scientific publications. (Instead of producing many, isolated papers, generating and accumulating knowledge and know-how in organized, overlapping areas will be encouraged).
- Introduce continuing-education courses to establish acquaintance and mutual trust, leading to deeper co-operation with private sector.
- Encourage joint theses proposals requiring collaboration with private sector.
- Encourage departments to establish an 'advisory council' composed of successful alumni to guide and assist the departments in policy development, curriculum update, etc.
- Encourage 'special study' courses offered by highly specialized, visiting private-sector representatives to stimulate students and faculty members.

5.3 Details of activities

In what follows, a description of the various activities carried out by Bogaziçi University is given, not only as related to university-industry linkages, but also in general. The narration and the figures quoted are based on a briefing report (Web Site of BU: European Rectors' Conference, see References) prepared by the University Rectorate in connection with the visit of a group of 25 European rectors during April 1997 (cf. also section 6.5).

5.3.1 *Continuing education*

Under this heading, only those types of educational activities of Bogaziçi University community directed towards a group which already has a university degree but seeks to improve professional skills or gain new ones, are considered. Educational activities directed towards high-school graduates or the general public are not included, as they are classified as 'income-generating' activities, although the income generated in this way reaches considerable amounts every year.

Four different kinds of activities that fall under continuing education are carried out.

MESSE seminars: These are one- to three-day seminars on popular subjects organized by a company owned by the Bogaziçi University Foundation (BUVAK), called Kampus. Kampus is in charge of all administrative activities connected with the seminars, including placing advertisements in the national dailies, leaving only the preparation of handouts and other training materials to the lecturer. The lecturer gets a fixed daily fee and the profit or loss goes to Kampus. Typical seminar titles have been finance, strategic management, environmental management, human resource management, economic and political developments in Turkey, etc. In 1996, a total of 39 public seminars (income: US\$155,000) and 28 in-house seminars (income: US\$133,000) were organized.

Bogaziçi University Foundation certificate programmes: These are 6- to 60-day events, the programmes of which are controlled by the academic council. These are underwritten by the foundation and the lecturers involved in the programme get a fixed daily fee for covering a part of the well-defined course outline. In 1996, only one programme was offered, with the title 'Executive Strategic Management Programme' and it grossed US\$152,000.

Bogaziçi University Certificate programmes: These are 6- to 30-day events controlled by one of the academic bodies of the university. The Director of the Programme controls the budget, financial transactions being carried out through Kampus, as well as the revolving fund system. The volume of activities in 1996 was US\$67,725, grossed for Turkish, Russian and Japanese language programmes.

Courses/seminars on a specific topic: These are events proposed by faculty members as one-time events on a specific topic, lasting usually one-two days. The organizer looks after the promotion, the administration, and the budget control on his own. Kampus and the revolving-fund system come in only for the financial transactions. The event may be repeated if a demand is felt. In 1996, the gross income from this type of activity was only US\$17,260.

At present, there appears to be a good potential to integrate continuing education into mainstream academic activities, such as undergraduate and postgraduate teaching. There is also potential to widen the scope of courses to faculties which have not been involved so much in continuing education activities, in order to avoid the common danger of creating ghettos of collaboration with industry within an institution. From an administrative point of view, it will be necessary to rationalize and formalize the use of appropriate pricing and costing structures and incentive mechanisms, many of which are already used by the different Bogaziçi University interface structures and which deserve university-wide dissemination.

There is also scope to reconsider the strategic role of Kampus for the future development of continuous education in the medium term. In particular, Kampus could play a more active role in the marketing of continuing education, the definition of a policy for continuing education, quality assurance, the development of learning resources and, finally, staff development. A more active involvement of Kampus would allow to take continuing education out of its isolation and give it institutional status and recognition.

5.3.2 Collaborative or contracted research activities

The main research-funding agency for Turkish universities is TUBITAK, in the form of grants. As can be seen from *Table 8*, BUVAK also contributes to the research efforts of the university through grants. The armed forces and ministries may also support some research activities in the areas that are of interest to them. The deliverables are then clearly specified and periodic monitoring of the project is carried out. Although this type of contractual research activity is rather new for the university, a number of large contracts have already been ensured, including one for almost a million dollars for the Defence Undersecretariat. Additionally, a few research contracts have been signed as subcontractors to NSF projects. With regard to contractual research to the private sector, it is not very common for the private sector to outsource any research activity because of the recent incentives that have been made available to them for doing the research themselves, as explained in Section 2.3.

Research in collaboration with the private sector usually takes place within the framework of international programmes. Bogaziçi University has been trying to increase its out-of-country linkages too, through becoming a partner with foreign industrial companies as well as Turkish ones in international research and development projects. There has been some successful bids made in this respect to the Eureka, COSY and

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INCO-DC programmes of the European Commission. The university has recently hosted a meeting, jointly organized by the European Commission, on strategies for the establishment of the Euro-Med (European-Mediterranean) Information Society. It is hoped that, as a result of this meeting, linkages will be established with both local and international companies active in information technology, to pursue projects under the framework of the EC MEDA (Mediterranean Development Area) programme.

In general, the exploitation of intellectual property rights from R&D collaboration with the private sector could be potentially a considerable source of income. At present, it is rather modest in terms of generated income and the European-funded projects tend to dominate among the ongoing initiatives.

It is recognized at BU, that R&D and other technology transfer should rely on decentralized initiatives for many individual projects. However, there seems to be scope for the consideration of a structural unit to support R&D and technology transfer at Bogaziçi University. Such a unit could mobilize the contribution from other university sources, such as the Foundations, but would also need to attract new partners and venture capital.

5.3.3 Consultancy

This is defined by Bogaziçi University as "short-term co-operation with the private sector, involving routine solutions to their problems, not generating new knowledge". Spending a day a week on a continual basis as a general adviser, or for a specific period of time in connection with a specific project, is a common way of interaction with industry for those professors who have an industrial facet. Most of these activities are carried out through Kampus, which receives the consultancy fee and pays out a certain percentage of it to the

consultants. The topics of consultancy can broadly be grouped into two: engineering (technological) and business. There is also a Total Quality Management Consultancy, which is given very effectively by a part-time member of the university. In 1996, the consultancy activities under the general headings of Strategic Management and Miscellaneous Consultancy (9 cases) totalled US\$47,670; Technological Consultancy (54 cases) totalled US\$141,680 and Consultancy on Total Quality Management (TQM) totalled US\$247,000 for a grand total of US\$436,350. However, this figure does not reflect the real volume of consultancy activities as some consultancies are not reported. Efforts are being made to improve organizational capabilities and to increase faculty sensitivity to transparency, to minimize such cases.

Kampus-channelled consultancy has a costing/pricing formula very much the same as continuing-education programmes, but it has not been disseminated to other units of the university. The situation may thus be defined as informal and where consultancy lacks institutional status.

5.3.4 Income generation

The university generates quite an important amount of income (almost \$4 million) through activities that reach out to the general public. From a social point of view, the most important of these are the educational courses offered to companies or the public at large without any prerequisites (generating almost \$1.3 million).

5.3.5 Other activities

In describing the endeavours of Bogaziçi University with regard to university-industry linkages, a series of other related activities is worth mentioning. One of these is the establishment of a UNESCO Chair on Mechatronics of the university, with the objective of promoting the philosophy of mechatronics and acting as a technology demonstration centre in this field. The Chair has initiated the creation of a UNISPAR

(This is an acronym for University-Industry-Science Partnership programme of UNESCO) Working Group by bringing together top administrators of large private enterprises and professors from different universities. One of the first projects that the Group was engaged in was the organization of the International Conference on Technology Management: University/Industry/Government Collaboration, that took place in Istanbul, during 24-26 June 1996. The main objective of the event was to explore the means and the instruments to establish effective and lasting university-industry-government co-operation and to present case studies in this respect. This conference and its extension in Turkish (aimed at the participants from the Turkish Government and industry) has helped to expose the capabilities of Bogaziçi University and the importance it gives to developing close relations with industry.

Some time ago, the UNESCO Chair on Mechatronics, together with the Mechatronics Research and Application Centre submitted a project to EU on the topic of Mechatronics Training and the Human Resources Development Centre. It has successfully gone through the screening stages and is about to be tied to a contract in which the EU contribution will be ECU1.8 million. It is hoped that the linkages of the university to the SMEs will be strengthened through this project.

6. The management of university-industry relations at Bogaziçi University

6.1 Strategic management of university-industry relations

A standing Strategic Planning Committee of advisory capacity was formed in 1992 to discuss and develop a vision for the university. The Rector directly appointed its members. After several iterations, a strategic plan, that has the goals of reaching international levels of excellence both in teaching and research, was formed by the Committee and approved by the Senate. It envisages a Bogaziçi

University that:

- excels in teaching but chooses to emphasize research;
- generates intense knowledge and experience in certain areas;
- aims to appeal to the society as well as the private and public enterprises.

In reaching the goals set, it aims at:

- an increase in the number of faculty members to 400 (presently 283);
- an increase in number of the graduate students to 1,800 (presently 1,288);
- a decrease in the number of undergraduate students to 5,000 (presently 6,457).

In terms of research, the goal is to identify certain areas where manpower and financial resources will be concentrated. Given the size of the university in terms of the number of faculty in a particular discipline (mostly 10-15 per department), this is seen as a necessity.

The strategic management of university-industry relations falls within the domain of the Vice-Rector for research and development. In this endeavour, he is assisted, to a great extent, by the Director of Bogaziçi University Foundation and, occasionally, by committees established by the Senate or other academic bodies. The policies are shaped at the Rectorate but the actual implementation and promotion may be handled at the faculties through the Dean's Office.

Up until recently, university-industry linkages at Bogaziçi University have grown organically, mainly based on individual initiative and, more recently, backed up by supporting structures such as the Bogaziçi University Foundation and Kampus. The university is moving slowly in the direction of becoming an entrepreneurial institution. In order

to give more visibility and credibility to the domain of university-industry linkages, Bogaziçi University intends to take a more proactive stance with regard to developing a coherent policy framework which would guide academics in their individual endeavours. It will also help to obtain cross-fertilization of activities.

6.2 Organizational and financial frameworks

In recent years, the factors behind the procedure of university-industry relations have changed. The creation of extrabudgetary funds and the diversification of the income basket have become an important consideration, both for the faculty involved and the institution.

The common mechanism for university-industry interface in Turkey has been the revolving fund system. This system is, however, more suitable for medical schools than others, due to high levels of overheads that, within the provisions of the related laws and regulations, have to be charged to the project owners. For example, out of every 100 (plus 15 per cent VAT) deposited into the revolving fund for a particular project, 10 is taken out as tax, 5 is deducted for a special fund to support faculty conference travel, 3 is for the use of the Rectorate and 1 is for another special fund. The expenses of the project are met from the remaining 81. About 31 per cent of what is left is set aside for the use of the unit (the department) that the project personnel is associated with, and the rest (69 per cent) is paid to the faculty involved in the project, which may be subject to 25-30 per cent income tax. So, assuming that there are no expenses involved in the project and the personal income taxation level of the faculty is 30 per cent, for every 100 that the faculty is to receive, about 256 plus 15 per cent VAT has to be paid to the university by the project owner.

This may be acceptable in medical schools, where there is a high level of state investment in terms of medical equipment and hospitals,

but cannot be justified and results in uncompetitive fees in other schools. Additionally, the system is subject to very tight rules and regulations, making it very difficult to effectively utilize the funds created.

Accordingly, universities have started establishing foundations to act as an interface in their dealings with the society. BUVAK is such a Foundation, established in 1978. For quite a number of years, it remained relatively dormant in fund-raising activities or in acting as an organizational vehicle for relations with the private sector. It was not until 1993 that it gained the tax-exempt status, meaning that any donations made to the Foundation would be tax-deductible. Today it is the most important interface that the university has with the society in general and with industry in particular. It has been trying to establish some general guidelines for such issues as the costing of staff involvement in consultancy activities, standardization of the consultancy and research contracts and the protection of intellectual property rights. As mentioned above, such rules need to be institutionalized and disseminated.

Another interface of Bogaziçi University is the company Kampus, established by the Bogaziçi University Foundation for continuing education and consultancy activities. In 1996, this company had generated almost \$1 million of income in terms of continuing education and consultancy activities. In such activities, the deductions, in addition to expenses, are 10 per cent for Kampus for handling the project, and 12 per cent is for the use of the school or the department that owns the project. The remaining amount is paid out to the project personnel, usually in the form of copyright royalties for the report that is delivered to the project owner or for the material that is prepared for the educational activity. Although the management of a consultancy or continuing-education activity through Kampus means less overheads, there are limits to what can be done in this way, especially in cases

where heavy use of university infrastructure is required, in which case, the revolving fund has to be the operational medium.

In addition to the activities of the Foundation, University Alumni Association BUMED, established in 1985, plays an active part in initiating and advancing university-industry relations. BUVAK-BUMED is named as the third sector of Bogaziçi University (neither private nor public, voluntary and non-profit making).

Bogaziçi University has recently developed new organizational frameworks and institutional policies in addition to the BUVAK. One of them is an innovation centre, a joint venture of Bogaziçi University and the Ministry of Industry SME Development Organization. This centre operates in a building of 1,000 m² and functions as a business incubator.

There is awareness that financial management policies and practices need evaluation with regard to a series of issues:

- income-generation targets for faculties;
- ground rules for transferring Foundation surpluses back to faculties;
- availability of (venture) capital for new developments;
- market-oriented costing and pricing policies;
- good financial monitoring information;
- consideration of the financial devolution to basic units and the rules to govern these arrangements in the medium and long term.

6.3 Personnel policies and incentives for faculties engaged in university-industry linkages

The faculty which is engaged in university-industry linkages does it more for financial reasons and the prestige it brings than for other reasons. Such efforts rarely result in publications and do not constitute a factor in academic promotion. Consequently, it is likely that those

faculties which do feel the financial need, will have little incentive in developing linkages with industry. It is only recently that an appreciation of such relations is developing. However, the salaries being what they are, the financial rewards are still the top incentive for getting involved in continuing-education courses or consultancies. A faculty member can earn up to 65 per cent of his personal income in this way. On the other hand, bringing funds to the university leads to some unwritten privileges, such as more support through BUVAK, priority in maintenance of the premises of active departments, and in allocation of staff or assistant support.

It is understood that there is scope at the university to set up reformed conditions of service and contracts to facilitate staff undertaking industry-related work, in particular visible reward mechanisms, promotion criteria, differentiated contracts and salary scales. There is also need for systematic training for new tasks and roles in collaborative activities with the private sector.

With regard to the managerial and administrative support functions which are necessary to facilitate a more systematic involvement of Bogaziçi University into university-industry linkages, a human resource development policy needs to be put into place. New tasks and roles in continuing education, R&D and income-generating activities have to be identified. At a second stage then, those existing staff who are able to cope with these identified tasks, as well as those who will require training, need to be identified. Some external experts might need to be recruited to match tasks to be performed with available staff competences. Such a proactive human resource development policy requires, of course, a flexible administrative framework for staff recruitment, as much as political will and an imaginative personnel department.

6.4 Protection of intellectual property rights

The issues of confidentiality and the protection of intellectual property rights in collaborative research activities with industry have been on the agenda of BUVAK for a long time. However, no standard policies or procedures have yet been established. It is left to the individuals concerned to work out suitable arrangements according to the particular case in hand. No urgency is felt in resolving the issues, since most university-industry linkages are not so deeply research oriented as to have a likelihood of resulting in a patent. In the case of collaboration in international groups, the protection models are already available and not subject to discussions.

6.5 The visit of European rectors and vice-rectors

In April 1997, a group of 25 European University rectors and vice-rectors was hosted by Bogaziçi University in connection with the University Management Programme of the Association of European Universities (CRE). During the visit, they were invited to undertake a review of the university's policies and practice in terms of relationships with the private sector. This was accomplished through the analysis of a briefing document and through structured interviews with about 30 colleagues from various parts of the university and executives from industry who have collaboration experience with the university. As a result, a report was prepared. Some of their observations and recommendations relating to university-industry linkages are presented below.

With regard to the continuing-education activities of the university, the group (referred to as CPD: Continuing Professional Development, by the group) recommended that, in the light of developing global philosophies, and given the elitist mission of Bogaziçi University, it should:

- actively differentiate itself from other providers by going for the high-level/high-quality executive/professional executive market with a strong international dimension – a regional provider for the South-East Europe-South-West Asia interface;
- base significant parts of its programme on upcoming twenty-first century trends;
- see CPD as a natural outreach of research;
- seek strategic alliances in CPD with large companies and international universities (its USA origins would clearly be helpful).

On the matter of consultancy, it was pointed out that the group was unable to discern explicit directions for development, financial targets, guidelines for the acceptance or rejection of project possibilities and guidelines on consultancy ethics or code of practice.

On research and technology transfer, the need for a more systematic approach was pointed out, the elements of which would seem to be:

- the fostering of critical-mass research groups for ensuring efficiency, short response, competitiveness, and avoiding disintegration of the research potential;
- the creation of incentives for researchers and research teams, and also for students, to participate in technology-transfer projects and receive credit for it;
- the institutionalization of formal linkages with the basic research institutes, like the Marmara Research Centre, to enhance basic research potential;
- the exploration and exploitation of the current legal norms for shaping the policy of co-operation with industry;
- the establishment of RTT as a major element of Bogaziçi University's mission and the discussion of RTT strategy across the university;

- the definition of the details of intellectual property rights for university and staff, and the design of suitably attractive means of profit sharing;
- the involvement of the social sciences in research transfer, as is demonstrable in many Western European universities.

The report also analyzed the entrepreneurial dimension of the university, the personnel policy and practice and the financial management policies and practices and made some observations and recommendations.

7. Conclusions

In this study, the experiences of Bogaziçi University in advancing university-industry relations are presented in a factual manner, from the viewpoint of an academic staff member who is not an administrator, but who has been involved in university-industry linkages in the university over the past 20 years.

University-industry linkages at Bogaziçi University have grown mainly organically, but also continuously within a context of financial stringency imposed by a diminishing public budget. Bogaziçi University, as an elitist Turkish institution, is benefiting from a high prestige which has facilitated continuing-education activities and consultancies, both representing a considerable source of income for the university.

At present, the university has a high potential to move into the direction of an entrepreneurial institution, but this would be highly // facilitated by a strategic management approach and the strengthening of existing management structures such as Bogaziçi University Foundation and Kampus.

There is also a case for greater institutional autonomy for Bogaziçi University vis-à-vis the Ministry. At present, the university's ability to maximize its potential is severely limited, because of stringent controls in the academic, personnel, administrative and financial domains which impose, at present, severe limitations to the development of the university's entrepreneurial nature.

**THE MANAGEMENT OF UNIVERSITY-INDUSTRY RELATIONS:
THE CASE OF THE UNIVERSITY OF SÃO PAULO, BRAZIL**

by

Guilherme Ary Plonski

THE MANAGEMENT OF UNIVERSITY-INDUSTRY RELATIONS: THE CASE OF THE UNIVERSITY OF SÃO PAULO

1. Contextual factors

1.1 General features

Brazil, with 160 million inhabitants, has the eighth largest GNP in the world – circa US\$800 billion, which corresponds to a GNP per capita of US\$5,000. In spite of an overall improvement in economic conditions, as a result of subduing the chronic high inflation by means of a smart strategy called 'Plano Real' in 1994, severe regional and social disparities remain. Indeed, the country is ranked 68th in UNDP's Human Development Index, and has one of the worst income distributions, as measured by the Gini index.

The State of São Paulo, where the University of São Paulo (USP) is located, has a population of almost 35 million (22 per cent of Brazil), that generates a GNP of US\$290 billion (36 per cent of Brazil), equivalent to Argentina; this corresponds to a GNP per capita of US\$8,350. Because of its economic strength, particularly of its industry, the State of São Paulo has been called 'the engine of Brazil'.

The current distribution of GNP in the State of São Paulo is as follows: commerce and services, 45 per cent; industry, 41 per cent; and agriculture and cattle, 14 per cent. In spite of a process of dispersion of industry to other regions in Brazil, the State of São Paulo maintains a definite lead in many sectors. For example, it is responsible for 65 per cent (1.1 million in 1997) of the cars produced in the country; as a comparison, the figure in 1990 was 0.5 million cars. This growth in economic activity is not translated in terms of formal jobs. The national unemployment rate is slightly above 8 per cent, while the current rate in the Greater São Paulo area (which comprises half of the state

population) is 17.2 per cent. There is obviously a high level of informal economic activity, unaccounted for in the labour statistics.

Private and public investment is flowing to São Paulo; the amount scheduled by local and foreign private companies (including known global corporations such as Motorola, Honda, Lucent, Ford, and BMW) for the coming years is US\$27 billion. If investment in infrastructure, which is being rapidly privatized, is included, non-volatile investment will add up to US\$50 billion.

A study recently released² shows that the State of São Paulo is the major source of Brazil's science and technology (S&T). In spite of being responsible for 35 per cent of the national expenditure in S&T, almost 50 per cent of the articles published in scientific journals and proceedings, and books, were written by São Paulo researchers. It generated 60 per cent of the patents received by residents.

1.2 Incentives for facilitating university-industry relations

During the 1990s, several federal and state programmes and funds were established, in order to facilitate the development of co-operation between industry and universities, mostly in the area of technology innovation. The major initiatives are summarized.

- (i) Law 8248: established in 1991, this law provides generous tax incentives for the information technology industrial sector, demanding, in exchange, that companies expend at least 5 per cent of its revenues in R&D. A substantial share of that amount (40 per cent, i.e., 2 per cent of the revenues) must be expended outside battery limits – in universities or research institutes. The incentives were reinstated at the end of 1999, with minor changes.

2. Fundação de Amparo à Pesquisa no Estado de São Paulo – *Ciência e Tecnologia em São Paulo nos Anos 90*. São Paulo, 1997. The study was developed by a joint team of USP and Universidade Estadual de Campinas; the author was a senior researcher.

- (ii) Law 8661: established in 1993, this law provides tax incentives for R&D investment by industry, and by agriculture and cattle companies. The amount of investment under this law already committed is circa US\$2 billion, with a ratio of 4:1 in terms of expenditure/incentive. In spite of not prescribing where the expenditures should be made, several new co-operation agreements were reported between industries, benefited by the law, and universities.
- (iii) FINEP-TEC: established in 1995 by *Financiadora de Estudos e Projetos* - FINEP (a funding agency of the Ministry of Science and Technology), this programme was specifically designed to promote industry-university co-operation. Companies were given soft loans for R&D, as long as at least 15 per cent of the expenditures were made in universities. The universities received additionally a non-returnable grant of 10 per cent of the amount loaned by FINEP to their industrial partner, as a stimulus to improve their research base. An initial amount of US\$25,000 was given by FINEP to 12 major public research universities, in order to lay the foundation or to improve a liaison office with industry. The programme was reviewed and discontinued, as it did not fulfil the initial expectations.
- (iv) PRODENGE/RECOPE: established in 1996 by the Ministries of Education and of Science and Technology, with funds from the Inter-American Development Bank, this programme promotes research networks among engineering faculty teams and companies.
- (v) ÔMEGA: this programme, established in 1996 by the Ministry of Science and Technology, promotes co-operative R&D. It demands that a university or research institute gets the interest of at least two companies.
- (vi) PADCT III: this is the Portuguese acronym for the third version of the Programme to Support S&T Development, which began

in 1997; it has funds in excess of US\$600 million, half of them as a loan from the World Bank. A substantial amount is channelled to the so-called 'Technology Component', which provides non-refundable grants for: (a) 'platforms', a setting where companies discuss their common technological bottlenecks and establish a joint research agenda, with the support of a university, or other knowledgeable body; (b) co-operative R&D, in a similar fashion to the ÔMEGA Programme described; (c) R&D contracted by industry from university; and (d) R&D by small business. In most cases, companies have to contribute with a sizeable amount of the costs.

(vii) SEBRAE: this is a national non-profit organization, created in 1991, aimed at promoting small business. It has been responsible for several innovative forms of relation between universities and small business, and for the incentive to entrepreneurship.

(viii) FAPESP/PITE: this programme, established in 1995 by the State of São Paulo Foundation for the Support of Research, provides non-refundable grants for university teams that perform R&D projects of direct industrial interest. It has a yearly budget of US\$5 million. Companies must contribute with 20 per cent to 70 per cent of the project cost, according to the risk involved.

2. Characteristics of the University of São Paulo (USP)

USP is the main university in Brazil, and São Paulo State's alma mater. Created in 1934, it has the usual three-dimension academic mission of teaching, research, and extension connected to teaching and research. According to the classification prevalent in the USA³, USP would be counted as a 'research university I'. It is considered one of the 100 top world academic institutions.

3. The criterion was proposed by The Carnegie Foundation for the Advancement of Teaching.

The number of regular students adds up to circa 60,000, distributed in six *campi* – São Paulo, Piracicaba, São Carlos, Pirassununga, Ribeirão Preto, and Bauru. This figure comprises 38,200 undergraduate students – in 129 courses, and 21,400 graduate students – in 254 master and 222 doctoral courses (93 per cent of which are rated A or B by the federal accrediting agency). The yearly number of participants in continuing education programmes is in the region of 100,000.

Each year 1,700 master thesis and 1,100 doctoral dissertations are concluded in its 35 schools, and 5 specialized institutes. USP's almost 5,000 faculties comprise over a thousand research groups, the largest number registered in the country.

USP is one of the three São Paulo State universities. Its yearly budget is circa US\$750 million⁴, which come from the state, as a percentage of the tax revenues. This budget also accounts for two hospitals and four museums. Other sources of income (grants, contracts with industry, etc.) are in the range of US\$180 million yearly. A sizeable additional amount of resources flows into the university system by way of private non-profit foundations connected to the different schools; these foundations provide consulting, continuing-education courses, contracted research, and other extension services, using universities' staff and students.

USP houses a large number of initiatives of co-operation with the economic and social milieu. A particular sensitiveness exists to the needs of K1-12 schools, and to contribution towards social cohesion; a recent survey showed more than 500 regular and permanent services in these fields, which were catalogued and are available on the Internet.

4. The money amounts were based on a R\$1.10 exchange rate for the US\$, before the strong devaluation that occurred in the beginning of 1999. At the end of 1999 the rate was around R\$1.85.

3. Past and current status of university-industry relations at USP

3.1 Development of university-industry relations prior to the beginning of the 1990s

USP has a long tradition of co-operation with industry. Indeed, some of its schools were always very connected to industry, both public and private, even before being absorbed into the university. This is the case of the Polytechnic Engineering School (in Portuguese, *Escola Politécnica*), founded in 1893 according to the model of the *Eidgenössische Technische Hochschule* of Zürich.

The co-operation expressed itself in several forms: student-supervised apprenticeship, continuing education, consulting, contracted and joint R&D, etc. A special issue of the university newspaper (*Jornal da USP*) in the beginning of the 1990s showed 300 formal ongoing agreements with enterprises⁵, mostly for joint or contracted R&D. Many other existent relations were not captured individually, such as student-supervised apprenticeships and continuing education.

The major developmental stages in the development of the relations of USP with industry can be associated to the evolution of industry itself. Three major stages can be identified: (i) the 1930s and 1940s, when industry was still incipient; (ii) from the 1950s to 1980s, when the modern industrial base was established - e.g., with the creation of the auto industry in the late 1950s, and the driving force was to substitute imports, and to develop local indigenous technology - e.g. the nascent computer industry⁶; and (iii) the 1990s, when the Brazilian economy opened to globalization, and competitiveness became the motto.

5. The issue was produced with special resistant paper, in order to be kept as a reference.

6. The first indigenous computer, nicknamed 'Ugly Duck', was developed in the Department of Electrical Engineering of the Polytechnic Engineering School. Its inventors created a spin-off company, called Scopus.

It has to be mentioned that a cross-fertilization existed between industrial and academic development. One of the main reasons for industry to establish itself in São Paulo was the availability of good labour, managerial, technological, and cultural infrastructure – due to USP and to other institutions. The new enterprises, on the other hand, posed new demands on the academy.⁷

USP's role exceeded by far just providing services to industry. It was instrumental in the creation of new models to organize industry. This is the case of the National Association of Industrial R&D Centres (in Portuguese, *Associação Nacional de Pesquisa e Desenvolvimento das Empresas Industriais* – ANPEI), which was incubated in the mid-1980s in the Centre for Technology Policy and Management of the university.⁸

3.2 Status of university-industry relations at USP during the 1990s

The co-operation of USP with industry grew in all modes during the 1990s. The number of ongoing formal agreements reached 500. The revenues of the foundations connected to the university increased strongly. The programmes described in item 1.2 facilitated the co-operation.⁹

Changes happened, frequently due to the new challenges to which the production structure was exposed, as a result of the change in the industrial and foreign trade policy. Some of the new responses of USP during the 1990s are highlighted:

7. This was the case, for instance, of the creation of the Production Engineering course and Department in the Polytechnic Engineering School in the late 1950s, by the recently deceased Professor Ruy Leme. The Department had had strong ties to industry since its inception.
8. ANPEI is a founding member of The Council of Industrial Research Associations of the Americas, which just had its first Conference, in Santiago, Chile.
9. For instance, USP was the first university to sign an agreement under the FINEP-TEC programme. It was a US\$2.4 million R&D contract with Pirelli, to develop new models to evaluate the resistance of energy cables for the off-shore oil industry. This project was contracted with the Department of Naval and Oceanic Engineering, of the Polytechnic Engineering School. The presence of a researcher of Pirelli's Technology Centre as a master student in the department was instrumental in promoting the co-operation.

- (i) The involvement with quality: Fundação Carlos Alberto Vanzolini - FCAV, connected to the Production Department of the Polytechnic Engineering School, became a key player in the area of quality systems management. It is the only internationally recognized local ISO 9000 certification body, with over 300 clients in Brazil and abroad. FCAV has trained thousands of company staff in the concepts and techniques of the new movement of quality. It is also a consultant to the State of São Paulo Programme of Quality and Productivity in the public administration.
- (ii) The involvement with small companies: as a result of a challenge posed by the Union of Small Industries in the State of São Paulo (known by the acronym in Portuguese: SIMPI), USP created in September 1991 a new user-friendly interface to facilitate access of small companies and entrepreneurs to its body of knowledge, and to the university staff. This interface, managed by Executive Co-ordination for University Co-operation (CECAE), became a highly successful service, called *Disque-Tecnologia* USP ('Dial Technology'). It has already provided technological and managerial support to more than 5,000 companies and entrepreneurs. It is interesting to note that a sizeable portion of the support is provided by undergraduate and graduate students, under supervision. Several spin-offs have been established, among others 'Atual-Tec' - a continuing education programme aimed at small companies, and 'Clip Tecnologia' - a radio programme to disseminate technological knowledge. This model was replicated in 16 other institutions in Brazil, and also in Argentina. The São Paulo State branch of SEBRAE has always provided invaluable financial support to this initiative.

- (iii) The involvement of undergraduate students: this was enhanced during the past years due to the creation of several 'junior enterprises' – a model, adapted from the French experience, by which students of a certain course or school establish and operate a professional services company focused on their area of expertise. Some of these enterprises developed a wide range of projects to industrial clients.
- (iv) The involvement with entrepreneurship: this increasing involvement happens through regular courses, continuing education programmes, business incubators¹⁰ and other initiatives.
- (v) The involvement with agribusiness: during the past five years a model programme of co-operation between USP and agribusiness was established by *Fundação Instituto de Administração* – FIA, a foundation connected to the Department of Management of the Economics, Management and Accounting School. Its acronym in Portuguese is PENSEA (in Portuguese, 'Thinks'), and stands for Programme of Agribusiness Studies. It became a national reference and meeting point of enterprises, government and academia interested in developing strategies for this most important economic area in Brazil.
- (vi) The international involvement: USP is the co-ordinating body of CYCOOP, which is the Ibero-American Network of Company-University Co-operation Management.¹¹ The

10. The most recent is CIETEC, an incubator established in its main campus area, with the partnership of the Institute of Nuclear and Energy Research (IPEN), the Institute of Technology Research (IPT), and SEBRAE – São Paulo and the State Secretariat of Science, Technology and Economic Development.

11. CYCOOP is part of CYTED, which is the Ibero-American Programme of Science and Technology for Development, through its Sub-Programme of R&D Technology Management.

university participates in initiatives of the Columbus Programme.¹² USP and its state sister universities are currently establishing a strategic partnership with Massachusetts Institute of Technology (MIT), in order to enhance co-operation with industry.

(vii) The legitimization of the involvement of private foundations: the number of private non-profit foundations, established by university bodies in order to manage co-operation projects with industry and government, has grown to 24. It is remarkable that a foundation – *Fundação de Apoio à Universidade de São Paulo* – FUSP – has been created by the University Council itself, presided over by the Rector.

(viii) The discussion on the involvement of the university with industry co-operation: a major result was the publication of a special issue of its respected magazine (*Revista USP* No. 25, March-May 1995), with 13 academic articles on this controversial subject. More recently, a special issue of the high-level academic Management Magazine (*Revista de Administração da USP* – RAUSP) was published on the third quarter of 1999, featuring 10 articles on the subject.¹³ This special issue was supported by *Instituto Euvaldo Lodi*, a branch of the National Confederation of Industry in charge of promoting industry-university co-operation. It is worth mentioning that the publication parties of both special issues were held at the headquarters of the powerful São Paulo State Federation of Industries.

12. USP is a member of the advisory board of Columbus' initiative focused on the relations between universities and small business, and a member of the respective ALFA network. USP is also a founding member, and member of the steering committee, of the Latin-American Network of Continuing Education (which has the acronym RECLA in Spanish), a spin-off of another Columbus initiative.

13. One feature of this special issue is an international roundtable on university-industry co-operation in the context of knowledge management, providing new and interesting insights.

4. The management of university-industry relations at USP

4.1 Strategic management of university-industry relations

USP does not have a written institutional policy geared towards the development of university-industry relations. However, this priority appears in specific documents, e.g. in the Guidelines to the Pro-Rectors, established by the current Rector, Professor Jacques Marcovitch.

Because of its size, diversity, and institutional responsibility as the main university in Brazil¹⁴, USP supports grass-root initiatives of co-operation with industry that respects the university's ethos.

4.2 Organizational development

Internal interface structure

USP is very decentralized. Therefore, each of the academic units establishes its own interface structures – offices, research and extension centres, foundations, etc.

The Central Council for Culture and University Extension and the Pro-Rector for Culture and University Extension provide the policy and general guidelines – for instance, what constitutes a continuing-education accredited programme. Each school has its Commission for Culture and University Extension, which is a locus for local guidance in matters pertaining to co-operation with industry, and with other entities in society at large. The Pro-Rector supervises circa 14 extension centres, some of which are involved in co-operation with industry.

There is a natural important involvement of the Pro-Rector of Research in matters of co-operation with industry, as he or she supervises almost 50 research centres, many of them connected to industry.

14. USP graduates and faculty members occupy routinely high positions in government and in industry associations. Currently, the President of Brazil is a former faculty member of USP.

Another actor is CECAE, the Executive Co-ordination for University Co-operation - which is directly connected to the Rector, and operates in close articulation with the Pro-Rectors, particularly with the Pro-Rector of Culture and University Extension. Through its University-Enterprise Co-operation Programme, which has the acronym USP-TEC¹⁵, CECAE provides information, overall support and stimulus to the faculties, and provides a gateway to industry into the university.

CECAE operates by programmes and projects, with a small cadre of circa 20 permanent people, including the senior and the support staff. The only faculty member is the Co-ordinator.

Its formal structure is quite simple. There are four 'university co-operation programmes', focusing on different segments of society, each one headed by a senior staff member: University - Industry, University - School System, University - Community, and University - University. The latter one was originally established as a programme to promote co-operation between USP and other universities, but proved later to be unnecessary - as co-operation with other universities became imbedded in the other three programmes. It now focuses on developing activities to enhance the quality of academic activities and of life in campus. There is a fifth area, in charge of 'Special Activities' (which became part of the name of CECAE as an Executive Co-ordination).

A typical project of the USP managed by CECAE has: (i) an 'executive co-ordinator' from its staff, who functions as project manager; (ii) an 'academic co-ordinator' who is a faculty member chosen for his or her competence and interest in the subject; and (iii) a 'planning

15. CECAE also has programmes of university co-operation with K1-12 schools, and with socially excluded communities. It manages several other initiatives - related to the internal environment, to new media technologies and others. The senior staff operate as programme and project managers, involving faculties, students and staff, and establishing partnerships with other universities, companies, government agencies and NGOs. A major current effort is *Projeto Avizinhar* ('Neighbouring'), aimed at generating new ways of forming relationship with the poor communities near the campus. Innovative forms of stimulating generation of jobs and income are being devised.

commission', formed by faculties, university staff, students and members from outside. This model provides the essential linkages with the academic community, respecting its decentralized nature.

There has been a tendency for some of CECAE's larger projects to include resources and competences from more than one programme, as is the case with the project Avizinhar, which is mentioned below.

A sample of current projects and activities is presented:

- *Disque-Tecnologia*. In English 'Dial Technology', this is a service which provides a user-friendly entrance for small businesses and new entrepreneurs to the competences available at USP. Since its creation in 1991, it has already dealt with more than 15,000 requests for help. A successful pioneering activity, this service has been replicated in 16 other institutions, covering Brazil from the Ceará State in the north-east to Rio Grande do Sul in the south, and in Argentina.
- *USP-TEC*. This project provides information, guidance and stimulus to university-industry co-operation in the field of technological-based innovation.
- *Avizinhar*. In English 'Neighbouring', it is aimed at establishing a positive interface between the university and the poor communities which live on its edges (and sometimes in areas which belong to the university). One component of this project is the search for new ways of generating income in these communities. As part of it, an innovative model of incubator is being established, namely, focusing on the incubation of popular work co-operatives.
- *SACI*. This is a multi-institutional project aiming at the inclusion of handicapped people (including the visually impaired) in the Internet, and the provision of added-value information on disabilities.
- *USP Recicla*. In English 'USP Recycles', combines education and technology, in order to promote environmental consciousness and soundness to USP's six campi.

- *UNIVÍDEO*. This project promotes the use of audiovisual technology for teaching and research purposes.
- *USPonline*. This project, which involves three other Co-ordinations, is responsible for the Web site of USP.
- *CIT-SP*. This project, developed in conjunction with the other two state universities of São Paulo State, is aimed at establishing a virtual technological innovation centre to increase international co-operation with institutions of excellence.

With regard to staff and services for university-industry projects managed by CECAE, differences are significant in the relations with small business and entrepreneurs, and with medium and large companies.

With the former, CECAE operates directly, through *Disque Tecnologia* and other related projects. The small staff are responsible for receiving the requests, screening them (which is a key process, because small businesses frequently 'don't know what they don't know'), providing the adequate source of competence in USP (or referring to other institutions), and follow-up. The adequate source of competence may be, and often is, a student in the specific field of the problem posed. CECAE has been working with, and stimulating the creation of, Junior Companies - which are professional businesses established by undergraduate students.

In the medium and large companies arena, CECAE has three main roles: (i) as a stimulator for co-operation; (ii) as 'second floor' resource - the actual interaction is managed by the research group or foundation; and, (iii) as an articulator, in sporadic cases of interaction that involve several groups in the university with one company.

USP's projects managed by CECAE are subject to the general rules and to the administrative restrictions that affect state-owned organizations. Therefore, CECAE tries to use FUSP as far as possible to manage its projects.

CECAE has developed a strong competence in managing co-operative interdisciplinary and inter-institutional efforts, bypassing the internal academic divisions and attracting partners outside USP.

Another important internal interface has been created at USP for the management of intellectual property issues. For this purpose a small office, known by the acronym GADI (which stands for Group to Support the Development of Inventions), connected to the University Law Office, has been set up at the university. It has been low-profile and reactive; therefore, its mission, size and status are currently being discussed, in order for USP to better cope with the new challenges of co-operation with industry. In 1998, GADI was transferred to CECAE. It had belonged to the Rector's Law Consultancy Office since its creation, 1989. With this change in institutional affiliation it is intended to enlarge the scope of activity of GADI and increase its proactivity in terms of commercialization of university knowledge. This is particularly relevant as new intellectual property law allows for patenting in the food and drug areas.

External interface structures

The prevalent external interface structures present at USP are the foundations. The first, FCAV, was created in 1967; today there are 24, some of them created by USP faculties in recent years.

Each foundation has its own managerial style and cultural idiosyncrasies and operates in a specific niche - for instance: industrial engineering; architecture and urbanism; medicine; economics; management or accounting. However, there are many common aspects.

1. The foundations resulted from grass-roots movements of some faculties in certain departments or schools, in order to facilitate their relations with the relevant external milieu.
2. The foundations are formally established as a private non-profit entity by the Curator of Foundations of the State of São Paulo.

This makes them eligible to receive grants from governmental agencies and to develop research-type activities and scholarships. Each year a detailed balance of activities and finances has to be provided to the Curator.

3. Despite their non-profit nature, the foundations generate considerable discretionary funds to the department or school to which they are connected, which help to overcome budget constraints. All foundations transfer resources in a direct way (e.g. monthly no-strings-attached money to a fund managed by the Dean or the Head of Department; or donating equipment used in projects), or by indirectly paying for items that otherwise would burden the university budget. Some of these foundations have a yearly turnover in the range of millions of US dollars, all coming from contracts.
4. The foundations sign a long-term co-operation agreement with USP at large; the interested department or school appears in the agreement as an intervening body; a certain amount of its income is forwarded to the university's funds to support research and extension.
5. The main reason to create a foundation has to do with the interest in getting flexibility in the day-to-day operation, in order to cope with expectations of industry and other potential clients. Particularly, there was a perceived need to overcome the limitations on the management of financial resources, imposed by law on USP as a public institution.¹⁶

16. For example, if a project contracted by industry requires 15 PCs to be purchased, a foundation can act in the market as any private organization, and the best combination of quality, price and delivery time will determine the solution. As financial resources are easily managed, the equipment might be available for the project team in a couple of days. The same need would take several weeks, or even months, to be fulfilled through the highly regulated public bidding procedure that the university has to follow; most suppliers would mark up their prices, some would not offer their products, as they prefer not to deal with public clients; and, one or two might even mess up the bidding process entering court because of some subtle interpretation of the terms of reference.

6. The governance model of the foundations is simple and common to all foundations. There is (i) a Board of Trustees ('Conselho Curador') staffed by faculties and, in some cases, people from outside the university, and (ii) an Executive Board, staffed by faculties; both are 'pro bono'. Usually, there is a small professional staff, mostly in charge of administrative support.
7. The specific statutes and modes of operation of each foundation are not subject to a common legal framework. The university does not impose specific items in the statutes or modes of operation. Each dean deals with the foundation(s) connected to his or her school or institute and acts as the intermediary between the foundation(s) and the central administration of USP.
8. All members of the directorship of foundations and most members of its overseeing council (called by law 'Curator Council') are faculty members. They are forbidden to receive any financial contribution for their administrative function, but are allowed to receive payment for their possible participation as teachers in courses organized by a foundation, or as project staff members.
9. The foundations allow a significant supplement to the faculty salary that is actively involved, and provides space in projects for graduate students.
10. In principle, the foundations benefit from a high level of autonomy. The communication with the alma mater is formally ensured through the governance model; however, relations have to be permanently cultivated. Tensions in relations may arise from time to time, usually as a result of the success of the interface structure. There exist also informal mechanisms that ensure communication between the alma mater and the foundation. For instance, there is a tradition, not a rule, that

the head of the Department of Industrial Engineering is a member 'ex officio' of the Board of Trustees of *Fundação Vanzolini* (the first foundation connected to USP, created in 1967 by the faculty of the department). This was to ensure social cohesion among the faculty body, some of which do not have any activity with or through the foundation.

11. The foundations might have their headquarters outside the campus, usually in the immediate neighbourhood; however, most of the activities - courses, projects, etc. - happen on campus, usually against a fee for the use of the university premises.

A particular foundation is FUSP, previously mentioned, as it is not connected to any school or department, but to the University Council, which is the highest board of USP. Therefore, FUSP operates as a central, albeit optional, external interface structure. As with all other foundations, it is non-profit making and operates under private law. The Rector is the President of the Board of Trustees (*Conselho Curador*, in Portuguese). FUSP is open to projects in every area, as long as there is an entrepreneurial faculty member who procures a project and is willing to manage it technically. FUSP will then assure the financial management of the project.

In all cases, a key to avoiding high tensions between the department or school and the foundation is openness to the participation of faculties, and transparency in the management of resources.

At present, there is no attempt either to centralize or to co-ordinate the multiple activities conducted by the different units of USP. In practical terms, a researcher has usually up to four options to manage a project: (i) directly as an individual; (ii) through the university; (iii) through the 'local' foundation, if there is one in his or her department

or school/institute; or, finally, (iv) through FUSP. The decision is made by the researcher according to his/her preference, but is strongly influenced by the boundaries provided by the client/partner and by the sponsoring/financing agency.

Networking arrangements

USP is involved in a number of networking arrangements in its co-operation with industry. In many cases, this network is mediated by a trade association; for instance, a highly successful continuing-education programme in production engineering developed by FCAV for Método, a construction company, led to three long-term contracts with the construction trade associations of Rio de Janeiro, São Paulo and Paraná States.¹⁷

USP is also increasingly involved in networking arrangements for R&D, which are being promoted by mechanisms such as RECOPE, ÔMEGA and PADCT III, already mentioned. Co-operative R&D might become a new trend, following the successful models widespread in the USA and in Australia.¹⁸ On the other hand, there are very few cases of industrial affiliation-type programmes.

4.3 Financial management of university-industry relations

A sizeable amount of extra-budgetary funds have been generated by the university system through interaction with industry. Some of them come directly from industry, and others are supplied by programmes such as FAPESP/PITE and FINEP-TEC. Because of the decentralization already mentioned, and the large number of external interface

17. On a personal note, having taught project management in these courses, the author finds it noteworthy that competing constructors could work together in ways to improve their managerial skills.

18. A recent doctoral dissertation by Eva Stal, under the supervision of the author, examines the possibilities and requirements of networking R&D arrangements in Brazil.

structures, resources flow in through many ways. Even contracts or agreements signed by the university are managed on a project basis, by the project co-ordinator.

Frequently, the university benefits from interaction with industry by receiving laboratories, buildings, equipment and material purchased for the project's purposes, or donated by companies. These facilities and inputs are available for the teaching and research activities, therefore alleviating pressures on the general budget.

At present, there are no university-wide guidelines or formulae for the costing of service contracts with industry. This allows for flexibility and for different situations to be handled differently. For instance, a consultancy project for a large company and a support project for a start-up firm cannot be dealt with in the same way. There are no uniform price policies. The general trend is, however, the following: the market-price model is used when the relationship is bilateral (university-industry). The full-cost model is used when the relationship is trilateral (university-industry-public funding agency).

The entrepreneurial pluri-institutional and decentralized approach that characterizes USP sometimes brings with it the undesirable effect, that prices may differ largely for proposals presented by faculties for activities of the same nature. There is awareness of this situation, and some foundations have established formal or informal ways of reducing discrepancies.

However, USP recently updated its rules for the distribution of funds generated through its activities (Resolution 4543, from 20 March 1998). These new rules have the following main characteristics: (i) the university funds for research and extension receive a 2.5 per cent cut on the amount of each contract (this taxation does not apply to the equipment and construction components of the contract); (ii) the

school may charge an additional fee, according to its own criteria, such as the use of facilities, etc. (beforehand, there was a uniform 2.5 per cent fee); (iii) the school charges a fee between 10-50 per cent of the personal income of its faculties in projects, keeping 95 per cent of this cut and forwarding 5 per cent to the research/extension funds.

The two main principles for modifying the old model were: (i) to establish a low floor for the contribution to the academic unit (10 per cent, as compared to 30 per cent before), in order to enforce the rule universally; and (ii) allow flexibility – the academic unit may charge between 10 per cent and 50 per cent, according to internal criteria. This enables units, for example, which provide different levels of infrastructure to the faculty involved in external projects to establish the percentage of contribution accordingly.

In case of economic benefits from industrial property, 50 per cent remains with the university (which bears all costs related to the patent deposit and maintenance), and 50 per cent goes to the inventor, i.e. the faculty or student. This procedure has existed since 1989, and was a pioneering advanced rule in the Brazilian university environment.

The university does not provide seed money or risk capital for joint ventures with enterprises.

4.4 Staff management

There has been a chronic problem of valuation of extension activities – co-operation with industry or any other extension work – both in the career advancement of faculties and the department appraisal. This has raised tensions between the internal evaluating bodies – dominated by the 'publish or perish' concept, and professional schools of USP, which emphasize market demand and actual technology transfer as a yardstick for competence.

An important step was taken by the Central Council for Culture and University Extension in 1995, by an initiative of the then Pro-Rector, and currently Rector, when 13 categories of extension were legitimized for evaluation purposes. The current challenge is to establish quantitative value to each activity, to allow for direct point-counting in competitive situations, e.g. between two or more candidates for one vacancy of full professorship.

The university has adopted, since 1989, the known MIT '80-20 per cent' model, allowing full-time faculties to devote an average of one day a week for extension activities, without limits for economic recompense.

One of the foundations of USP has developed a unique training programme (known by its acronym PROTEU) for university-industry interface managers, open to university staff, company professionals and agency personnel. This programme aims at enhancing the capability of managing the interface between academia and the business sector; it has been running successfully since 1995, with a strong attendance of university liaison managers from other Latin American countries. It has the support of FINEP, the Brazilian funding agency for technology innovation, and of CYCOOP, the Ibero-American network of Company-University Co-operation Management.

4.5 Management of contracts and intellectual property

USP has a model for a 'memorandum of understanding', and for an 'agreement', drafted by the Law Office. These drafts are based upon the requirements of Law 8666 and later changes, which define rules for contracts signed by the public administration.

Any contract at the university follows a step-wise procedure: (i) the interested party writes a draft, preferably based on the model mentioned, or receives a draft from industry; (ii) the draft is approved

or amended by his or her Department Council; (iii) the draft is approved or amended by his or her School's Commission for Extension; (iv) the draft is sent to the Rector's chief of staff office, which forwards it to the Law Office; (v) the Law Office examines the draft very carefully, and writes a detailed legal appraisal; (vi) the University Commission for Budget and Assets examines the draft, with the Law Office's appraisal, evaluating the economic and financial impact or risk to the university, and gives or not its approval; and (vii) the Rector, or the Vice-Rector on the Rector's behalf, signs the contract, after examining the conclusions of steps (v) and (vi). A recent resolution by the Rector (published on 22 October 1999) provides detailed guidelines for the approval of contracts and work agreements, among other reasons in order to safeguard the university against future claims by personnel contracted with a project budget.

This rather long procedure can be leapfrogged by using 'ad hoc' approvals in steps (ii), (iii) and (vi), if urgency is required. Step (v) has to be followed through no matter what, before coming to the last step. The key is starting the draft from the right model. CECAE is providing a page in USP's Internet site, called GUIA-TEC ('Tech-Guide'), where most relevant information is available for a researcher interested in formal co-operation with industry, including the models mentioned. Most schools have a small support structure, attached to the respective Extension Commission.

Contracts signed by a foundation have a much shorter procedure: (i) the interested party writes a draft, usually without any pre-formatted general model, or receives a draft from industry; and (ii) the draft is approved by the foundation board and signed by its President, or by two incumbent directors. Some more sophisticated foundations have a Law Assistant, who examines the contract in advance.

The contracts are managed in a decentralized way. A joint account of the university and the Project Manager is opened, and a report has to be sent by the Project Manager to the Finance Department at the end of the contract. If there is support from funding agencies, their specific procedures have to be followed.¹⁹ Each foundation has financial management procedures of its own.

Regular contract monitoring and quality control are usually substituted by examining the credentials of the Project Manager, and by the response of the clients. Some foundations establish from time to time explicit mechanisms - quality assurance auditor, ombudsman, etc., but they do not usually last very long.

In the case of continuing-education activities, there are typically forms for the participants to evaluate the course, sometimes during and always at the end. They are usually taken seriously by the co-ordinators of the respective continuing-education programmes.

USP has a clear policy regarding intellectual property rights, which accepts shared ownership. Conditions for publication of research results might be established in individual contracts, but there is as yet no general policy.

Intellectual property issues are managed by a small structure (GADI) attached to CECAE; its role and current limitations have already been addressed.²⁰

19. Each agency has a different operational procedure. For instance, FINEP provides money to the institution. FAPESP, on the other hand, only provides money to the principal researcher, who is personally responsible for the project's management and report (even if it involves a multi-million dollar sum).

20. The recent Rector's resolution (published on 22 October 1999) includes a provision that all expenses incurred in patenting the results of a research contract must be paid up-front by the company; whenever income from licensing shall occur, the amount paid will be accounted for.

5. Evaluation of the benefits and drawbacks regarding relations with industry

There has not been any overall internal/external evaluation of the joint programmes with industry. However, this is taken into account in the external evaluation of the university departments, and in the internal evaluation of research and extension centres.

There is a long list of benefits derived from co-operation with industry, and any enumeration would be rhetoric. In fact, one cannot imagine a school such as the Agriculture School (known by its acronym in Portuguese as ESALQ), which is almost one hundred years old, without its strong ties to enterprises.

The main benefits generally perceived in the academic community are the following:

- (i) Evidence of responsiveness of USP to the needs of society, particularly of small business. This has been politically important in the current situation of the public-funded universities as a whole being labelled as elitist and selfish by segments of society, under pressure from the private education business lobby.
- (ii) Acquisition of knowledge about local problems suitable to be used as case studies in teaching or as triggers of faculty and student research, stimulated by the possibility of immediate utilization of the results.
- (iii) Establishment of channels that facilitate the access of USP's students to job opportunities in top companies, mainly by supervised apprenticeship.
- (iv) Flow of funds for research or consulting that enable more faculty members to stay full time at the university, therefore helping to maintain the desired level of presence.
- (v) Support for the establishment of up-to-date laboratories.

There are no main drawbacks per se. Nevertheless, problems have occurred in some contracts, most of which were overcome.

Some of the general problems that were encountered are:

- (i) Tensions among faculties that arise from the differentiation in income among faculties as a result of different levels of successful involvement with the economic outside world. It has to be noted that the principle of isonomy applies throughout the university, i.e. two faculties with the same seniority and academic level will receive exactly the same basic salary.
- (ii) Fuzziness between the roles of members of the university community and business entrepreneur of some faculty involved in both activities, resulting in private appropriation of publicly funded research without proper material and moral compensation.
- (iii) Lack of time for structured learning by gifted students, who are very much attracted to the apprenticeship opportunity in competitive business such as in the finance industry.
- (iv) Managerial problems, such as lack of proper provision of funds to pay the social benefits of staff contracted for a specific project.

The main general lessons are: (i) it is best to develop lasting co-operative relations, rather than considering it a buyer-seller relation; (ii) mobility of people is very important to promote interactions; and (iii) project management techniques are very important in order to enhance the chances of delivering the right results.

6. Future prospects for the development of relations with industry

It is the policy of the current Administration to intensify co-operation with industry, contributing to the regional and national innovation system. The prospects for USP are very good, as it has a strong research base and a tradition of active interaction with the external economic and social milieu.

Some of the visible trends are:

- (i) Increase in the demand from industry, due to needs that arise from the knowledge-based internationalized economy.
- (ii) Stricter supervision by the university regarding issues such as intellectual property rights, disclosure of funds received by faculties, and adherence to proper budgeting and reporting practices.
- (iii) Emphasis in mediating systems such as business incubators and technology parks.
- (iv) Mainstreaming of entrepreneurship training for students.
- (v) Widespread use of university managerial models that focus on co-operation with small business and job-creation. This leads to USP formally becoming an adviser to other institutions (this has already been happening informally).

**THE MANAGEMENT OF UNIVERSITY-INDUSTRY RELATIONS
AT MAKERERE UNIVERSITY, UGANDA**

by

Avitus Tibarimbasa and Eriabu Lugujjo

THE MANAGEMENT OF UNIVERSITY-INDUSTRY RELATIONS AT MAKERERE UNIVERSITY, UGANDA

1. Contextual factors

1.1 Economy

Uganda has a dominant informal economy and the population has been mainly sustained by the largely subsistence agriculture, with inherent low productivity and limited marketable surpluses which cannot generate adequate incomes or meet the demand from manufacturers and modern services.

Uganda's economy has grown by 6.5 per cent per annum over the past decade. However, fluctuations in growth have been registered, notably in dry periods that affect agricultural outputs. The big influence of the performance of the agricultural sector on overall GDP growth is due to its dominance in the economy. Although gradually declining, the share of agriculture to overall GDP is currently about 44 per cent, of which food crops account for over 28 per cent.

Although agriculture is still dominant, the structural composition of economic activity in Uganda has been changing during the past 10 years. For example, during 1996/1997, total agricultural output accounted for 44.1 per cent of GDP as compared to 45.5 per cent in 1995/1996, 51 per cent in 1992/1993, and 57 per cent in 1987/1988. This downward trend shows the reduction in the over-reliance of the economy on agriculture. In contrast, the manufacturing sector now accounts for about 8.4 per cent of total economic output as compared to other developing countries. This ratio needs to be significantly increased, especially through the processing of agricultural outputs into semi or finished products.

Albeit for the small base, provisional estimates indicate that the manufacturing sector grew by 14.2 per cent per annum in 1996/1997, somewhat lower than the 19.7 per cent registered in the previous year. This compares with growth rates of 70 per cent, 15.1 per cent and 17.3 per cent achieved in 1992/1993, 1993/1994 and 1994/1995 respectively. The industrial sector, as measured by the overall index of Industrial Production, rose by nearly 17.0 per cent from 1995 to 1996. The index of main manufacturing, based on the eight major manufacturing sub-sectors (that is, sugar, beer, soft drinks, cigarettes, textiles, cement, electricity, and laundry soap and edible oil), showed an even better performance. The index rose from 230.5 in February 1996 to 303.5 in February 1997, an increase of 31.7 per cent.

The Government of Uganda is committed to implementing its programme of privatization, with the target of divesting 85 per cent of public enterprises by the end of 1998. As of December 1996, a total of 63 public enterprises, including subsidiary units, had been divested. During 1997/1998 government emphasis was on privatization of larger public enterprises, with specific emphasis on public participation through share sales to the general public.

This accelerated approach to privatization is in line with aspirations of the Uganda Investment Code which became law in January 1991, requiring rationalization of the mechanisms of investment approval and introducing further incentives, including duty- and tax-free facilities, exemption from co-operation tax and tax on dividends. This also provides protection to local and foreign investors. The investment code facilitated the creation of the Uganda Investment Authority (UIA) to act as a one-step centre for investors and to promote investment opportunities in the country.

The modern industrial sector and international co-operation

The modern formal industrial sector comprises enterprises mainly supplying the home market with modern technology and services. The sector includes computer and telecommunication technology as well as services for special equipment and production tools. A substantial part of the businesses are foreign businesses or are jointly owned with foreign companies. Due to this close relationship, the production structures of these companies are comparable to worldwide models. In regard to this similarity, the labour organization and technology of this sector can be characterized as follows:

- micro-electronics has a high impact on productivity and labour organization of the companies;
- electrical and mechanical components are integrated parts of a product;
- hardware and software are directly linked in the production and services process.

The rationalization strategies of the modern industrial sector in Uganda can best be described as total quality management, job rotation and job enlargement. As a result of these strategies the working segments of low-qualified workers and their middle management are excluded from the system.

The formal industrial sector for internal markets

This formal industrial sector includes small car workshops and construction companies, consultancy services etc. It is characterized by the extreme need to catch up after the long period of stagnation in Uganda. The main interest of the consumers is to obtain the products quickly, at a low price.

To satisfy this consumer demand, production is connected with low technology and capital input of unskilled workers trained on the job. In a situation of stability and satisfaction of the elementary needs, combined with rising income of the population, quality and finish of products will become more important. The effect of this development can be a rising demand for low- and medium-level practical skilled workers and appropriate technology.

Besides the formal industrial sector, Uganda has a thriving and fast-growing informal sector which promises a bright future, ease of entry and low and flexible skill requirements. It consists of an urban informal sector in Uganda which comprises small entrepreneurs who own their means of production (owner operators); paid or unpaid establishment workers (wage-earning employees, apprentices and unpaid family members); independent workers (self-employed); and casual workers. The National Manpower Survey (1988) estimated that about 14 per cent of the labour force was employed in the urban informal sector, compared to 5 per cent of those in the formal sector.

The rural informal sector includes peasants who are engaged in small-scale agricultural and non-farm activities. The main areas of employment are processing of agricultural products, production and servicing of adapted technical equipment for agricultural production, as well as production and sales of wood and leather goods.

Although the informal sector is the most vibrant area in terms of employment generation, its development is hampered, among other things, by lack of formal technical and vocational training and adequate funding. This sector has now reached a stage at which further growth is not possible without strong and effective support from government, aid agencies, business communities and people at large, all of them acting in co-ordination.

Regional economic and industrial co-operation

There is a new initiative of East-African co-operation (consisting of Kenya, Tanzania and Uganda) which is based on the creation of an enabling environment for the establishment of a single market. The approach to regional co-operation will rely more on market incentives than on administrative discretion, as with the private sector. This calls for the adjustment of strategies of the private sector to make contribution to, and also influence the development of, the single market and investment area. East-African co-operation will encourage the development of private-sector institutions at the East-African regional level and encourage cross-border investment, joint ventures and increased trade in goods and services. It is also hoped that these developments will lead to harmonization of training and certification of the labour force in the region.

The framework set out in the East-African Co-operation Development Strategy was made with the recognition of the fact that if the region has to be internationally competitive, its competitiveness will come from within individual firms and business organizations.

It has been realized that one of the major barriers to promoting regional trade and investment in this part of the world has been inconsistent fiscal and monetary policies. These will be gradually harmonized within the region and Ministries of Finance of the three countries have agreed to consult with one another before their annual budgets are presented. Indeed, a timetable has been agreed for the greater harmonization of fiscal policies.

The development of physical infrastructure such as roads and telecommunications, both at the regional and country levels, is critical to the facilitation of trade and improved production efficiency. The improvement of infrastructure will offer the private sector of the three countries an opportunity to access greater markets for their products and exploit further the principle of specialization.

All the above efforts will require competent human resources both at research and managerial levels. In this case university-industrial co-operation and revitalization, both at the national and regional levels, will be inevitable.

1.2 National/regional programmes for university-industry linkages

National programmes

At present, national programmes for university-industry partnership exist at Makerere University, Faculty of Technology, and Uganda Polytechnic, Kyambogo. Historically these programmes arose from the academic requirement that any student aspiring to graduate with an engineering degree or diploma must undergo industrial and workshop training for a prescribed time and undertake industrial projects. Furthermore, engineering degree/diploma curricula are designed with the following in mind:

- role of an engineering graduate/technician in local industry;
- avenues of employment and/or academic advancement;
- internationally expected standards of a graduate engineer/technician;
- the need for well-trained personnel in industries.

It is obvious that the role of training competent engineers and technicians falls squarely on industries and universities. They should play a symbiotic and mutually inclusive part in the socio-economic development of the country.

Until very recently, government has been entirely funding the upkeep of students in industries; and the industries have been providing training materials and offering free utilization of their equipment. However, with the advent of privatization of higher education, all private students must

pay for their upkeep and transport during industrial training. It is still debatable whether private students will pay for the actual training and consumable materials.

Regional programmes

There are a number of collaborative academic programmes within the umbrella of the existing Inter-University Council of East Africa. Some of these programmes have involved streamlining curricula in engineering disciplines as well as attempts to harmonize qualifications.

There is still need to develop a Regional Qualification Framework (RQF) as a basis for certification and accreditation of training achievements and categorization of programmes. This approach will facilitate and, in the long run, eliminate the cumbersome process of gauging equivalencies of degrees/diplomas within the region.

2. Characteristics of Makerere University

2.1 Background

Makerere University had a humble beginning, having been established in 1922 as a technical college offering courses in medical care, veterinary science, agriculture, elementary engineering (crafts courses), survey and teacher training. In 1949 it became a university college with a 'special relationship' with London University. It then started to offer courses leading to the general degree of London University.

In 1963, when the University of East Africa came into being, Makerere dropped its 'special relationship' with London University and became a constituent college of the new university. Makerere achieved full university status with the enactment of the 1970 Makerere University Act. The Act provides a legal framework and modus operandi of Makerere as a fully-fledged university.

Makerere University offers courses leading to the award of diplomas, and degrees up to Ph.D. level, in most faculties. The current faculties are: Agriculture and Forestry, Arts, Commerce, Fine Art, Law, Medicine, Social Sciences, Science, Technology, Veterinary Medicine, Education, Librarianship and Institute of Social Research, Statistics and Applied Economics and a Centre for Continuing Education.

Apart from Makerere University, higher education (education offered beyond full secondary education) is offered by other universities, polytechnic institutes, colleges and other such institutions affiliated to them.

2.2 Aims and objectives of higher education in Uganda

The government White Paper (1992) makes the following recommendations, setting the goals for all higher institutions:

- train high-level technical, managerial and professional manpower for all sectors of the economy;
- generate and promote advanced knowledge and innovations through research which aims at adapting them to national needs and situations;
- enhance and support the provision of public service through expanded extra-mural or extension work and consultancy services;
- develop the intellectual capacities of students to understand and appreciate in an objective way their local and national environment;
- promote the development of an indigenous scientific and technological capacity needed for tackling the problems of development;
- equip the students with knowledge, skills and attitudes to enable them to join the world of work as useful members of their communities and the nation at large through being:

- committed to and ready for community and national service voluntarily and when mobilized to do so;
- nationally conscious and tolerant of others and willing to work anywhere with fellow nationals;
- productive individuals with positive attitudes towards personal, community and national development, as well as believing in the dignity of labour and displaying a willingness to be involved in productive and practical work.

Specifically the major missions of Makerere University in today's society should be:

- (i) *the intellectual mission*, comprising, on the one hand, the teaching function to assure the preservation and transmission of knowledge, science, culture, and, on the other hand, the research function, which permits the Makerere University community to contribute to the advancement of scholarship in a climate of freedom and autonomy where monitoring, evaluation and criticism are essential elements;
- (ii) *the social mission*, comprising, on the one hand, the vocational function to train specialists and professionals and highly qualified manpower and, on the other hand, the service function which provides a range of services and expertise for the economic, social and cultural development of society;
- (iii) *the education mission*, comprising, on the one hand, the *cultural function*, which forms the intellect and promotes the full potential of each individual, and, on the other hand, the *humanistic function*, which ensures the acquisition of the basic concepts and ideas inherent to a general education, as well as an understanding and appreciation of other cultures of the world.

Some of the above missions of the university are challenged vehemently by the general public, whose resources are invested into higher education with very little tangible, beneficial and realistic outcomes. Universities are now challenged to:

- produce graduates not only to carry out research, but to manage its application in industry and business;
- become instrumental in the transformation of rural areas and stamp out abject poverty by becoming true partners in development.

2.3 Academic programmes and research priorities

Academic programmes are broad and diverse and encompass physical sciences (physics, chemistry, mathematics, botany, zoology, geology); technology (civil, electrical and mechanical engineering); surveying; architecture; environmental studies; medicine; veterinary medicine; dentistry; pharmacy; agriculture and forestry; food science and technology. Also taught include statistics; economics; physical planning; commerce and business studies; library and information science; arts; fine art; social studies; languages; music and drama; computer science; and women's studies. Research priorities are also wide and diverse, but are mainly concentrated in food science and technology; agriculture; environment; alternative sources of energy; social sciences; and human and veterinary medicine.

It should, however, be pointed out that funding basic academic research does not attract much donor sympathy. In fact, the socio-economic and educational benefits accrued from such research are underestimated.

2.4 Student numbers

Besides diversifying courses of study, Makerere University has widened its doors to Ugandan students through the private sponsorship

scheme. This scheme has forced the institution to conduct evening programmes in order to preserve quality while, at the same time, serving increased numbers of students. During the past three years the number of private students has doubled to 5,597. The total student population in 1995/1996 was 9,469 and in 1997/1998 stood at 12,269. Makerere University has a number of institutions affiliated to it offering awards of Makerere University. In addition, about 1,500 students take courses leading to external degrees of the university in commerce and education. Table 1 illustrates this information clearly.

2.5 Staff numbers

The shortage of staff at Makerere University originated from the exodus of trained staff between 1970 and 1986. Political strife and economic hardship at that time did not spare educational institutions. The university has had to launch a recruiting drive over the past 10 years from within its graduating students. The staff is therefore predominantly young. As Table 2 shows, only 35 per cent of the professorial positions are filled and yet, in the category of lecturers and assistant lecturers, out of the 614 established posts, 608 are filled, indicating almost a 'no-vacancy' position. Overall, the number of filled posts average 74 per cent, as Table 2 shows.

Table 1. Makerere University: Student enrolment by course and year of Study 1995/96 - 1997/98

Faculty/Institute/ School		Course	Sponsor	1995/96					1996/97					1997/98					Total				
				Year of Study					Year of Study					Year of Study					Year of Study				
				I	II	III	IV	V	I	II	III	IV	V	I	II	III	IV	V	I	II	III	IV	V
Agriculture and Forestry	B.Sc. (Agric.)	Gov't	75	81	79	83	318	83	75	81	79	318	75	73	71	81	321						
		Private	4	5	0	0		9	13	4	5	0	22	9	4	2	6	21					
	B.Sc. (For.)	Gov't	30	30	32	31	123	33	30	30	32	125	38	29	30	30	138						
		Private	1	2	0	0		3	4	1	2	0	7	9	2	0	0	11					
	B.F.S. and Techn.	Gov't	20	19	17	20	76	21	20	19	17	77	22	20	18	15	97						
		Private	7	0	0	0		7	11	7	0	0	18	12	5	1	4	22					
B.Sc. (Agric Eng.)	Gov't	16	20	16	15	67	17	16	20	16	69	18	19	14	19	70							
	Private	0	0	0	0		0	2	0	0	0	2	0	1	0	1							
Sub-total	Gov't	141	150	144	149	584	154	141	150	144	589	153	141	133	145	572							
	Private	12	7	0	0	19	30	12	7	0	49	30	12	3	10	55							
Arts	B.A. (Arts)	Gov't	378	235	252		865	338	378	235	951	329	291	254	874								
	Private	185	6	11		182	200	165	6		371	163	103	74	340								
B.A. (Arts) Evening	Private	101				101	400	101			501	53	400										
	Gov't	24	20	21		65	19	24	20		63	24	15	14	28								
B.A. (Mass Comm.)	Private	5	0	0			5	2	5	0		7	4	2	3	9							
	Gov't																						
B.A. (Mass Comm.) Evening	Private	73				73	50	73			123	27	50										
	Gov't	46	36			82	60	46			106	32	28										
M.D.D.	Private	0	0				0	0				5	0										
	Gov't																						
Sub-total	Gov't	448	291	273		1012	417	448	255		1120	385	334	268	987								
	Private	344	6	11		361	652	344	6		1002	252	555	77	884								

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Table 1 continued

Faculty/Institute/ School	Course	Sponsor	1995/96					1996/97					1997/98					Total				
			Year of Study					Year of Study					Year of Study					Year of Study				
			I	II	III	IV	V	Gov't	Private	Total	Gov't	Private	Total	Gov't	Private	Total	Gov't	Private	Total	Gov't	Private	Total
Commerce	B. Comm.	Gov't	99	106	91			296			105	99	106				310			109	108	95
		Private	1	0	0				1		5	1	0				6	11	7			20
		Gov't	0	0	0			0			0	0	0									0
Sub-total	B.B.A. Evening	Private	445	0	0				445	240	445						685	239	240	445		924
		Gov't	99	106	91			296			105	99	106				310			109	108	95
		Private	446	0	0				446	245	446						691	250	247	447		944
Education	B.A. (Educ.)	Gov't	227	225	216			668			230	227	225				682			199	211	212
		Private	45	22	17				84	30	45	22					97	0	24	13		37
		Private	38						38	450	38						488					
Sub-total	B. Sc. (Educ.)	Gov't	82	59	42			183			80	82	59				221			89	77	76
		Private	0	1	0				1	20	0	1					21	27	11	2		40
		Gov't	309	284	258			851			310	309	284				903			288	288	288
D.W.	D.D.B.	Private	83	23	17				123	500	83	23					606	27	35	15		77
		Gov't	70	59	63			192			74	70	59				203			56	78	68
		Private	14	4	1				19	30	14	4					48	62	10	2		74
Sub-total	M.B.Ch.B.	Gov't	0	0	0			0			0	0	0				261	14	120			134
		Private	94	24	23				148	120	94	24	23									
		Gov't	70	59	63			192			74	70	59				203			56	78	68
Medicine	B. Pharm.	Private	108	28	24				167	150	108	28	23				309	76	130	2		208
		Gov't	90	98	106			499			90	98	106				481			76	91	100
		Private	13	2	0				16	20	13	2	0				35	19	23	10	5	0
Sub-total	B.D.S.	Gov't	10	8	14			42			10	10	8				42			13	7	10
		Private	0	0	0				0	5							5	4	1	2	1	8
		Gov't	10	10	14			47			10	10	10				50			10	10	10
Sub-total	B. Sc (Nurs)	Private	0	0	0				3	5							8	3	1	0	0	3
		Gov't	9	0	0			17			15	9	10				34			11	13	11
		Private	1	0	0				1	4	1	1					6	0	2	1	0	3
Sub-total		Gov't	118	116	134			605			125	119	126				807			110	121	131
		Private	14	2	3				20	34	14	3	3				0	54	26	27	13	6
		Gov't	14	2	3																	

The management of university-industry relations
Five institutional case studies from Africa, Europe, Latin America and the Pacific region

Table 1 continued

Faculty/Institute/ School		Course	Sponsor	1995/96					1996/97					1997/98					Total				
				Year of Study					Year of Study					Year of Study					Year of Study				
				I	II	III	IV	V	I	II	III	IV	V	I	II	III	IV	V	I	II	III	IV	V
Science	B. Sc.	Gov't	361	289	302			952	330	361	289			980	300	284	351			935			
		Private	7	4	0			11	66	7	4			77	57	22	6			85			
Sub-total			368	293	302			963	337	367	296			987	307	306	357			935			
Social Sciences	B.A. (SS)	Gov't	317	404	387			1108	300	317	404			1021	309	358	400			1067			
		Private	189	69	40			298	100	189	69			358	246	117	111			474			
B.A. (SS) Evening		Private	301					301	450	301			751	351	450				801				
B.A. (SWASA)	B.A. (SWASA)	Gov't	50	49	44			143	50	50	49			149	47	51	50			148			
		Private	17	9	5			31	5	17	9			31	17	4	10			31			
Sub-total			67	58	49			174	55	67	58			180	64	55	60			179			
Technology	B. Sc. (Eng.)	Gov't	82	63	69	59		273	82	63	69			214			64			64			
		Private	23	12	3	1		39	23	12	3			38			3			3			
Civil	Civil	Gov't							30					30	31	30	30			91			
		Private							12					12	11	12	4			27			
Electrical	Electrical	Gov't							25					25	26	20	29			75			
		Private							12					12	21	14	3			38			
Mechanical	Mechanical	Gov't							25					25	25	23	23			71			
		Private							12					12	14	3	3			20			
B. Arch.	B. Arch.	Gov't	12	13	6	6		49	15	12	13	6		52	15	14	13	6		18			
		Private	6	0	0	0		6	5	6			11	5	8	2	1			16			
B. Surv.	B. Surv.	Gov't	15	12	14	11		52	15	15	12	14		56	15	11	13	15		54			
		Private	0	0	0	0			10					10	2	2	0	0		4			
Sub-total			109	88	89	76		127	110	109	88	89		112	112	98	108		403				
Vet Medicine	B.V.M.	Gov't	40	41	47	35		207	40	40	41	47		203	35	47	42	34		203			
		Private	1	0	0	0		1	5	1			6	5	0	0	0		5				
Sub-total			41	41	47	35		208	45	41	41	47		209	40	52	42	34		208			

Table 1 continued

Faculty/Institute/ School		Course	Sponsor	Academic Year										Total	Gov't	Private	Gov't	Private	Total	Gov't	Private	Total										
				1995/96					1996/97																							
				Year of Study					Year of Study														Year of Study									
			I	II	III	IV	V	Gov't	Private	I	II	III	IV	V	Gov't	Private	I	II	III	IV	V											
F.A.S.I	B.I.I.S.	Gov't	36	31	39			106		45	36	31			112		21	37	43													
		Private	12	9	5			26		15	12	9			38		29	11	5													
	C...(Studies)	Gov't	0	0	0					0																						
		Private	39	0	0			39		30					30		5															
Sub-total		Gov't	36	31	39			106		45	36	31			112		21	37	43													
		Private	51	9	5			65		45	12	9			68		34	11	5													
I.A.A.C.E.	D.A.E.	Gov't	23	11				34		35	23				58		22	10														
		Private	0	0						0					0		0	0	0													
	B.Comm (External)	Gov't	0	0	0	0	0			0							374	200	312	103												
		Private	312	103	56			471		200	312	103	56			671																
	B. Ed (External)	Gov't	0	0	0	0	0			0									0	0												
		Private	235	38	0	0	0	273		250	235	38	0		523		174	250	235	38												
Sub-total		Gov't	23	11	0	0	0	34		35	23	0	0		58		22	10	0	0												
		Private	547	141	56	0	0	744		450	547	141	56		1194		548	450	547	141												
I.S. & A.E.	B. Stat	Gov't	59	52	68			179		70	59	52			181		34	57	55													
		Private	19	8	7			34		0	19	8			27		18	23	8													
Sub-total		Gov't	59	52	68			179		70	59	52			181		34	57	55													
		Private	19	8	7			34		0	19	8			27		18	23	8													
Margaret Trowell School of Fine & Industrial Arts	B.A. (F.A.)	Gov't	38	44	46			128		40	38	44			122		40	40	33													
		Private	32	0	0			32		30					30		42	13	10													
Sub-total		Gov't	38	44	46			128		40	38	44			122		40	40	33													
		Private	32	0	0			32		30					30		42	13	10													
Total		Gov't	2219	2015	1935	381	171	6771		2206	2219	1978	414	144	8380		2021	2352	2065	371	103											
		Private	2750	818	371	5	1	2038		2813	2723	348	82	0	5748		2032	2135	1200	101	1											
																					9459											12306
																																12269

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Table 2. Makerere university: Summary of current academic staff establishment and staffing strength - 1997/1998 Academic year

Faculty / school / Institute	Established posts						Filled												Total		% (Filled/Est.) per faculty / school / institute
							P		AP		SL		L		AL						
	P	AP	SL	L	AL	Total	M	F	M	F	M	F	M	F	M	F	M	F	Total		
Agriculture & forestry	13	15	26	41	17	112	7	0	4	0	18	2	29	15	14	6	72	23	95	84	
Arts	12	15	28	53	15	123	4	1	5	1	15	4	40	11	14	1	78	18	96	78	
Commerce	2	4	8	12	4	30	0	0	0	0	1	0	10	0	1	0	12	0	12	40	
Education	8	14	22	36	10	90	4	0	4	0	9	4	26	13	7	6	50	23	73	81	
Law	4	6	10	15	4	39	1	0	2	0	9	0	13	6	0	0	25	6	31	79.5	
Science	15	21	36	60	10	142	10	0	13	1	21	1	45	10	11	1	100	13	113	79.6	
Medicine	31	23	55	93	31	223	9	1	12	1	31	3	53	16	14	0	119	21	140	62.8	
Social sciences	12	15	28	46	12	113	2	0	1	0	10	4	37	16	15	1	65	21	86	76.1	
Technology	10	10	20	36	8	84	0	0	3	0	10	0	32	3	20	4	65	7	72	85.7	

Veterinary medicine	9	11	20	24	10	74	2	0	5	0	10	2	19	4	21	1	57	7	64	86.5
ISAE	6	6	15	24	6	57	2	0	1	0	3	0	19	5	5	3	30	8	38	66.7
IACE	1	2	6	15	2	26	0	0	0	0	4	2	6	4	0	2	10	8	18	69.2
EASL	1	1	2	3	0	7	0	0	1	0	1	0	2	0	1	0	5	0	5	71.4
Fine art	4	6	10	15	6	41	0	0	1	0	5	1	6	4	4	2	16	7	23	56.1
MISR	2	2	4	16	0	24	0	0	0	0	1	0	5	5	0	0	6	5	11	45.8
Total	130	151	290	489	125	1185	41	2	52	3	148	23	342	112	127	27	710	167	877	Overall (filled/Est.) Average % 74.0

Source: Planning and development department personnel section - US\$ department

Key: P: Professor
AP: Associate professor
SL: Senior lecturer
L: Lecturer
AL: Assistant lecturer
VL: Visiting Lecturer
PL: Part-time lecturer

ISAE: Institute of Statistics and Applied Economics
EASL: East African School of Librarianship
IACE: Institute of Adult and Continuing Education
MISR: Makerere Institute of Social Research

2.6 Budgeting in the university

Makerere University is still a public institution, drawing most of its funds from the central government. Although enrolment of private students has increased, their fees are heavily subsidized by government by up to 50 per cent. In drawing up the budget, the Bursar requests departmental heads to submit their needs for the following year. In particular, in the academic departments, they must estimate costs of essential inputs (consumables, equipment, office expenses, etc.). In *Table 3*, budget and expenditure for years 1994/1995, 1995/1996 and 1996/1997 are shown.

Table 3. Budget and expenditure 1994-1997

Year	Estimates (1 US\$ = 1,050 Uganda Shs.)	Expenditures (1 US\$ = 1,050 Uganda Shs.)
1994/95	13,713,000,000	17,597,427,684
1995/96	20,238,433,000	18,720,936,007
1996/97	20,942,394,000	19,602,351,353

The university will have to diversify its sources of funding in order to recruit more staff to cater for more students, equip workshops and laboratories, and also diversify curricula to take care of changing demands of the market. Also, modern technologies will have to be acquired for efficient delivery of lectures, especially in the humanities/arts.

3. Past and current status of university-industry linkages

3.1 Development of university-industry relations prior to 1992

The Faculty of Technology was established in 1970 with the departments of Civil, Electrical and Mechanical Engineering. Since then, however, departments of Architecture, Surveying and a sub-department of Engineering Mathematics have been added. The annual student intake in the first year has grown steadily from the initial enrolment of 27 to the current 160. Present total student enrolment stands at 490, of whom 55 are female students.

Main linkages

Traditionally, it has been a faculty requirement that every student pursuing a degree in any engineering discipline must undergo a specified period of industrial training in a recognized industrial establishment. This exercise is normally carried out at the end of each academic year for a duration of 10 weeks (usually July-September). For those completing the first year, they do their training within faculty workshops and installations. All students are supposed to present a clear and well-written report, endorsed by their training supervisors-instructors. These reports are formally submitted to heads of departments of their representative disciplines. These reports are supposed to be marked on a pass/fail basis.

Mode of industrial training

During the period 1975/1988, the faculty did not have an industrial training officer who would liaise with industries/enterprises, although an established post existed. It remained unfilled because it did not carry a competitive remunerative package. In this case, heads of departments would issue letters of introduction to students to carry to industries. The students would approach industries almost in an ad hoc manner.

Those who were lucky would be taken in at the first trial, but many ended up spending weeks looking for placements.

There was not any agreed formal training between the faculty and industries. The responsibility for training was entirely left to personnel in industries, with faculty staff paying casual visits in the guise of industrial supervision.

This situation was not deliberate. Most staff had left the faculty, and in fact industries were also equally strained both in the human resource and infrastructural set-up. Faculty staff concentrated more on theoretical lectures, supervision of laboratory sessions and final-year projects.

The students likewise noted these weaknesses. Those who needed pushing did not do well in their industrial training and inevitably gained very little practical experience.

This was also the time when government parastatals were decaying and inefficient, but they continued recruitment of the few students who were graduating from the faculty. There were very few engineering projects in industries and most of the students missed their pupilage training. In fact, some ended up as managers within their first years of work after graduation.

Status of industrial training

There were no formalized and institutionalized linkages between industry and the university. Programmes and contents of training programmes were not discussed by lecturers in the faculty and instructors/supervisors in industries.

Due to the weak industrial base that existed, there were never enough places to absorb all the students during industrial training. Most industries were not operational due to economic hardships and political instability.

Industrial training, while considered as an integral and important part of the student training, has continued not to constitute part of the overall assessment for the award of a degree. This has, as before, led students to relax and lack seriousness during training. Absenteeism/irregular attendance, and sometimes presenting poor industrial reports, were the consequences.

Staff exchange

Because of the shortage of staff in the faculty, a few patriotic workers would visit to give a few lectures, sometimes at no cost. The rates paid by the university were too low to attract experienced, committed industrial workers.

A few lecturers engaged in consultancy services with industries did not put much effort into teaching. Eventually, most of the lecturers left the faculty for more lucrative consultancy fields.

In a number of cases, young lecturers employed on a full-time basis by the university would spend most of their time in consultancy work outside. This was indeed to the detriment of the students.

Major development stages for university-industry relations

(i) Government policy

The goal of the Government of Uganda for industrialization is to establish a strong, viable, sustainable and internationally competitive industrial sector, integrated with the rest of the economy through cross-sectoral linkages. Among the specific objectives for achieving the above goal are:

- using and adding value to the country's vast natural resources and creating new markets;
- increasing private-sector participation in industry;

- creating new job opportunities to absorb the fast-growing labour force;
- encouraging industrial research and development;
- facilitating the use, adaptation and transfer of advanced technology.

Among the strategies to achieve the above objectives, the following are envisaged:

- attraction of both domestic and foreign investors through a conducive 'Investment Code' that offers a package of incentives to investors;
- promotion of private sector-led economic development;
- investment in human resources development;
- encouragement of small-scale industries as a means of promoting industrialization;
- ensuring availability and reliability of supportive infrastructure.

This government's industrial policy demands total mobilization of the trained workforce to participate in national development. Indeed, university and industry partnership has had to follow.

(ii) Knowledge-based industry

Although Uganda is predominantly an agricultural country, the government vision for the year 2025 indicates clearly that future growth and development will depend more on knowledge-based industry. That is why government is challenging all tertiary institutions to maximize their contribution to industrial development.

With the present government policy of attracting investors, there is belief that knowledge-based industry will be critical for the competitiveness of conventional industries.

(iii) Growth in university-industry linkages

The university realized that there was need to carry out target-oriented research, however basic it might be. There has therefore been a growing need to turn basic research into products. The universities emphasized the need to link their research to prototype and incubator development and industries. On the part of industries, they know that well-trained people are efficient and reduce wastage in the production process. They would therefore aspire to be partners in the development of human resource if proper protocols of collaboration could be worked out.

Under government vision and policy there has always been a wish to encourage industries to contribute to higher education funding through scholarships, research and development, endowment of Chairs, and infrastructure development of direct-grant disbursement.

3.2 Status of university-industry linkages since 1992

Consultancy services

The Faculty of Technology staff members established a Consultancy Company in 1992 within the faculty. It is known as *Technology Consults Limited (TECO)*. The objectives of TECO are:

- to develop the professional status of the academic staff;
- to extend technical specialist services to the community by solving practical problems in local industries;
- to generate extra income for faculty programmes and staff members.

TECO services cover the following range of options:

- technical services in electrical, mechanical and civil engineering;
- technology-development services;
- professional development training services;

- workshop services;
- architectural services;
- surveying services;
- any other pertinent projects from industries.

Technology Consults (TECO) status

TECO is a firm based in the Faculty of Technology, Makerere University. It was established as a result of the realization by members of staff that, while many of them were practising individually off-campus, they would make a more effective group if they combined the wide range of competences and expertise under one umbrella. TECO was therefore formed as a private limited-liability company with members of the faculty staff (senior technicians and above) as shareholders. It was incorporated in 1992.

Operational structure

TECO policy is established by a Board of Directors (see Figure 1) currently composed of the following:

Chairman	:	Dean of the Faculty of Technology
6 Members	:	Heads of Departments/Division
1 Member	:	Financial Director/Business Manager
1 Member	:	External Director
1 Member	:	Secretary to the Board
1 Member	:	Assistant Business Manager.

TECO draws on the expertise of about 25 in-house consultants who cover most areas of the various technical disciplines. However, where in-house capability is not available, TECO works with other consultants and consulting firms on specific projects. Collaboration with outside consultants and firms also helps TECO build capacity and experience in areas where there might be insufficient experience.

Day-to-day running of TECO is under a Business Manager/Financial Controller who is assisted by an Assistant Business Manager. The Dean of the Faculty and the Business Manager are the two signatories to the Account of TECO. The Business Manager is assisted by two administrative assistants, a draughtsman and two secretaries.

The Business Manager of TECO, who is also a full-time academic member of staff, is indeed combining both tasks, notwithstanding the presence of two assistants at his disposal. Communication by the TECO management team with academic staff has been smooth as they are the sole shareholders of TECO.

Main activities of TECO

The main activities and scope of TECO fall primarily in the category of consultancy services in the following key divisions:

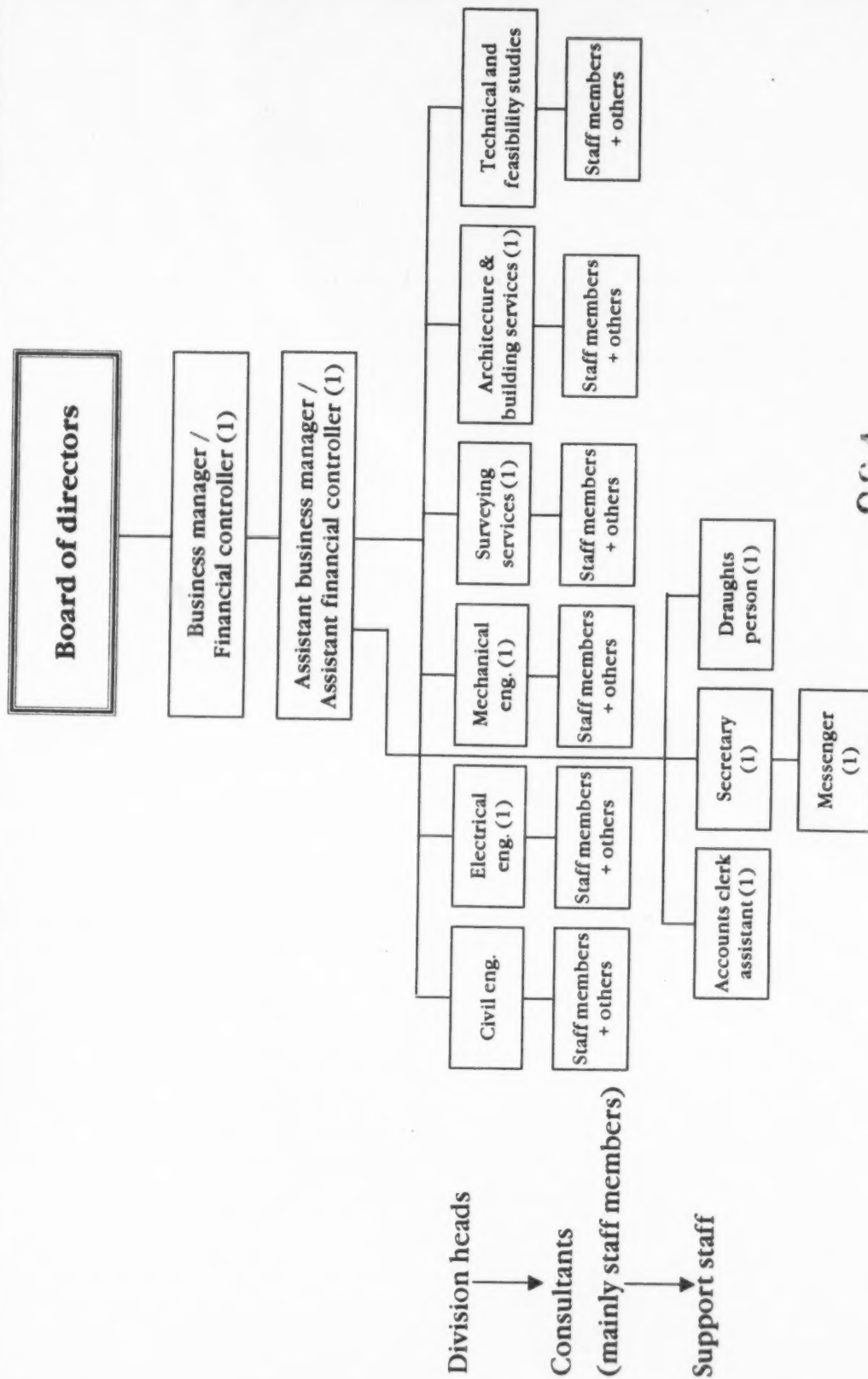
Building consultancy services

- advising on site development;
- site investigations;
- full design and documentation (architectural, electrical, structural and civil);
- quantity surveying;
- supervision of works.

Computer services

- data processing;
- software development;
- system planning and design;
- specialized training.

Figure 1: TECO structure and management



Expert technical services

- geo-technical investigations;
- materials treatment, analysis and testing;
- water-quality analysis;
- communication systems/sub-systems design;
- energy auditing;
- valuation of machinery and equipment;
- energy studies and analysis;
- environmental impact assessment;
- development of production systems;
- air conditioning and refrigeration systems design, power systems and sources;
- quality management.

Technical and Feasibility Studies in Engineering technology and related fields

Surveying services

- cadastral, geodetic and topographic surveys;
- digitization of survey information;
- land information services.

Civil works

- full design, documentation and works supervision for roads, highways, drainage systems and irrigation systems.

Training

- TECO trains students in consultancy skills and principles;
- mounts short-term courses tailored to the needs of clients (industries/firms).

Research and development

- at present no significant breakthrough has been achieved, although there are a few joint projects between staff members and industries.

Spectral aspects of TECO

- Consultants (staff members) are not full-time employees of TECO. They have no retainer salary from TECO, but they are paid a fee on each completed project they participate in.
- TECO is a one-stop consultancy centre and industries find it more convenient to interact with it.

The Uganda Gatsby Trust (UGT)

Uganda Gatsby Trust (UGT) is another vehicle for university-industry linkages at Makerere University. Co-operation with small and medium-sized enterprises was started by the Faculty of Technology with the help of a generous grant from the Gatsby Foundation.

The faculty had, for a number of years, realized that small-scale enterprises within the informal sector presented potential growth areas. It was noted that training, if well-conceived and delivered, would benefit individuals, enterprises and society at large. Training would help individuals in this sector to upgrade their skills, improve their prospects of finding and retaining a job or creating a job, improve their productivity and thereby contribute to raising their standards of living.

In addition, the faculty staff had been challenged for a long time to address problems of a local nature, thereby contributing to endogenous national development. Faculty response to this challenge has facilitated the collaboration process with small-scale industries.

UGT was established at the Faculty of Technology in 1994. The mission of UGT, which is a non-governmental organization, in Uganda,

is to: "Assist in developing the technological base of the small enterprise sector in the country and enabling the growth of such enterprises".

Specific objectives of UGT are:

- to develop a network of micro-enterprises linked to the Faculty of Technology, Makerere University, in order to increase the quality and value of their output;
- to introduce students to the opportunities and potential of the small-scale sector and assist them to develop technologies appropriate to it;
- to avail staff in the faculty opportunities to anticipate and appreciate needs of local communities.

Activities of UGT

The Uganda Gatsby Trust implements several activities which enable close interaction between the faculty staff and students and the entrepreneurs, especially in the small-scale sector. These activities fall within the following categories:

(i) Training courses

The faculty staff organize tailor-made training courses for managers and artisans of small-scale enterprises to address managerial and technical skill deficiencies.

(ii) Business advisory services

UGT sends staff members to offer extension services to identify interested enterprises with the aim of:

- diagnosing their problems and formulating solutions;
- preparing well-articulated and costed business plans for the enterprises.

(iii) Student attachments

UGT enables engineering students to be attached to small-scale enterprises for their industrial training period. This enables them to appreciate the problems and potentials of the small-scale sector. Hopefully, some of them will start up micro-enterprises upon graduation.

(iv) Student projects

UGT supports final-year engineering students in their efforts to design and produce appropriate prototypes. The hope is to transfer the technology developed to the industries.

(v) UGT clubs

The UGT sets up Gatsby Clubs in selected towns to enable and facilitate constant interaction between UGT members within a given club.

Organizational structure of the UGT

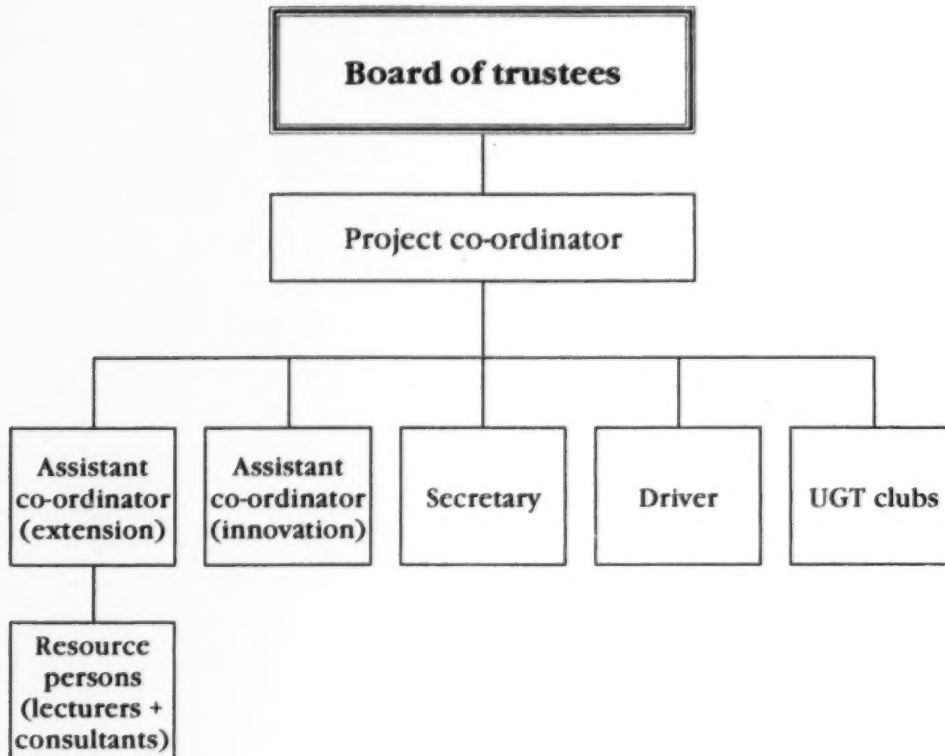
The Trust is administered internally by a Project Co-ordinator (General Manager) who is assisted by two Assistant Project Co-ordinators, viz:

- Assistant Project Co-ordinator - Extension
- Assistant Project Co-ordinator - Innovation.

At the moment of drafting this case study, these three individuals were lecturers in the faculty. The main resource persons for this scheme were the highly skilled faculty staff and some co-opted consultants from other faculties, especially that of Commerce, or in town as need arose. Since academic staff are the resource persons for the UGT, the project co-ordinator finds it easy to communicate with them and also relate to them.

The organizational structure within the faculty is shown below in Figure 2.

Figure 2: Organizational structure within the faculty



3.3 Faculty of Commerce

The Faculty of Commerce offers a series of short-term management development programmes to various organizations in the public and private sectors, on the basis of demand, and also invariably undertakes consultancy to business organizations and government departments.

Management development programmes

Management development programmes include:

(a) Regular off-the-shelf programmes which focus on:

- management for young executives;
- accounting and finance for non-finance executives;
- effective communication skills;
- customer service;
- case-writing workshops.

(b) Tailor-made programmes

These depend on the requirements of the client, but include strategic management, business planning, and some of the above courses in (a) above.

Consultancy services mainly include the following:

- conducting selection interviews;
- drawing up feasibility studies;
- drawing up marketing plans;
- various other forms of management consultant services.

These courses are co-ordinated by a Faculty Committee chaired by the Dean. The profits accrued are shared among the staff, faculty administration and the university central administration. The percentage given to each party is under serious discussion.

3.4 Staff exchange

The Faculty of Technology is not only experiencing staff shortage, but also requires, urgently, experienced practical engineers to work part-time in the faculty. A few engineers from industries deliver some lectures, but their policy is not institutionalized. There are a number of problems impeding, but the most significant is the low remuneration attached to the workload.

4. Management of university-industry relations

4.1 Strategic management of university-industry relations

The University Council, which is the supreme governing body of the university, passed the following minute:

"The university will continue to strive for excellence in teaching and academic research while putting great emphasis on commercial activities or projects relevant to the academic mission of the university. The university will stimulate academic involvement in commercial activities by the creation of a climate in which academics will be willing and able to interact with industry and by the planned development of policies, procedures and structures to facilitate such activities".

The university supports, and indeed encourages all faculties to create collaborative linkages with industries, markets and the public. One of the missions of the university is to translate knowledge into national development. It therefore regards university-industry collaboration as one of the channels of achieving this mission.

As of now, however, university-industry management can be regarded as a faculty-driven activity, with the central administration playing a marginal role only.

4.2 Organizational development

Interface structures

Organizational development for the management of university-industry linkages has been particularly prominent at the Faculty of Technology. Both TECO and UGT are examples for the creation of external interfaces. The Uganda Gatsby Trust (UGT) is particularly interesting in this respect, since it aims at a particularly wide outreach within the country through a decentralized local club structure.

External UGT Club structure

The Uganda Gatsby Trust (UGT) is continuing to set up clubs in selected towns to enable constant contact and interaction between UGT-member small enterprises for greater impact. Specifically the clubs are set up to:

- establish core membership of the UGT to operate with and ensure demand-driven services;
- establish an institutional framework in target areas for continued UGT support to improve impact;
- enhance savings and credit schemes through group membership and peer-group pressure;
- raise funds for UGT through membership subscriptions to the UGT Clubs.

Management of UGT Clubs

Each club is managed by an elected Executive Committee comprised of:

- Chairperson;
- Vice-Chairperson;
- Secretary;
- Treasurer;
- Committee members (2)

Sometimes a representative of the Co-operative Bank and UGT Headquarters can attend the Executive Committee meetings, if available. The members of the committee serve on a voluntary basis and are responsible for:

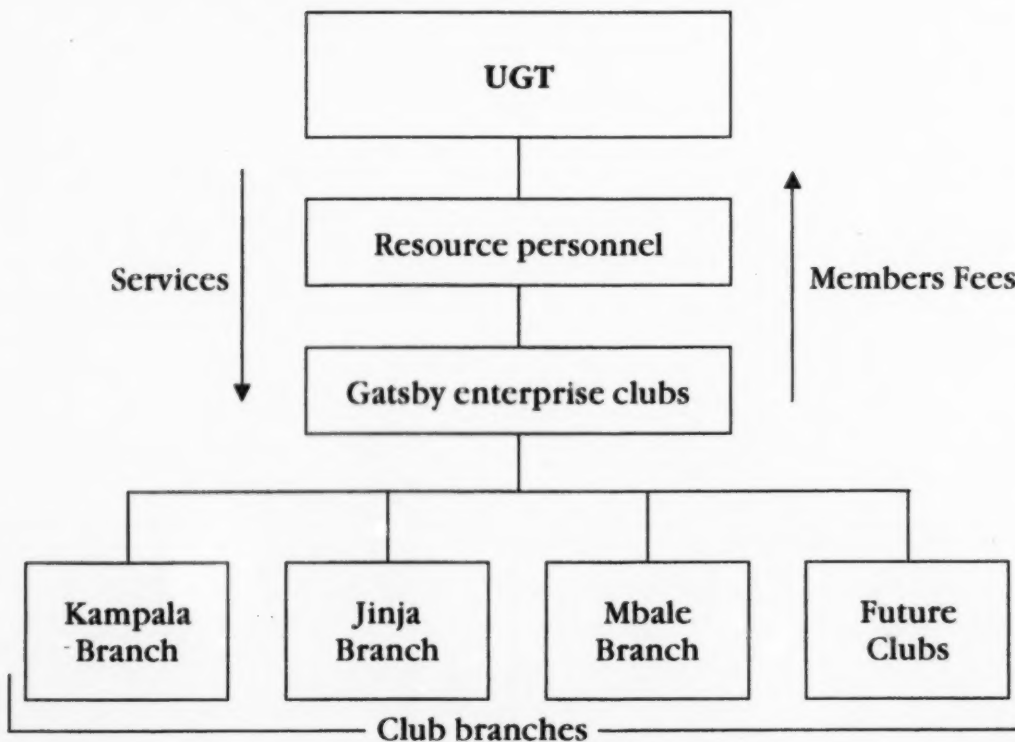
- organizing all branch activities such as seminars, training courses, etc., with UGT providing the funding and resource personnel;

- liaising with local authorities and Co-operative Bank branches;
- organizing club members into groups for purposes of them borrowing and cross-guaranteeing each other for the loans, while establishing peer pressure;
- running a Savings Scheme in which all members contribute and save funds for emergency lending to the members (own resources);
- liaising constantly with the UGT Office at the Faculty of Technology, Makerere University, Kampala;
- managing the operation of the local showrooms which are used as avenues for marketing of members' products;

Linkage between UGT and Gatsby Clubs

The linkage between the Trust and Gatsby Clubs is summarized in Figure 3 below:

Figure 3. Linkage between the UGT and Gatsby Clubs



The supervision and monitoring of club activities sometimes pose problems. The project has experienced a number of major crises in this respect which have adversely affected the growth of the UGT.

The Gatsby Centre for Enterprise Promotion (GCEP)

Finally, the UGT has established what is known as the Gatsby Centre for Enterprise Promotion (GCEP).

This centre is charged with:

- technology development plus technology transfer to the small-scale sector;
- generating funds for sustainability of UGT activities;
- enterprise promotion.

The GCEP can be considered at present as a variant of a small-scale business incubator whose importance is slowly mounting.

4.3 Financial management of Makerere University-industry relations

Uganda Gatsby Trust

At present, financial management and control of Uganda Gatsby Trust is vested in the Board of Trustees and the Project Co-ordinator. Two Board members, one of whom is its Chairperson, together with the Project Co-ordinator, are the signatories to all the financial transactions of the Trust. The Trust is audited annually to the satisfaction of all Board members and other stakeholders.

The major income of the Trust comes from the interest generated from the seed money lent out to members of the Uganda Gatsby Trust. This income is supplemented by that generated through the Gatsby

Centre for Enterprise Promotion, where technology transfer and specialized services are offered to small-scale industries. Formation of UGT Clubs in major towns in Uganda has increased membership and, accordingly, annual subscription. Strict financial control within UGT in all its activities aims at:

- creating a sustainable national revolving fund;
- training all stakeholders aspiring to become successful entrepreneurs to be frugal;
- instituting a culture of recognizing that the Trust is 'their Trust' and therefore must be managed effectively.

In terms of financial sustainability of the UGT, the following mechanisms are interesting to note:

Demand-driven services

UGT recruits member SMEs who pay fees for the services provided by the UGT. This is the major source of income. Currently, UGT has about 200 members each paying US\$100 per year as members' subscription.

Endowment Fund

UGT puts any surpluses from operations towards an endowment fund to earn interest for the Trust. Currently the endowment fund stands at US\$100,000, earning 15 per cent per annum.

Revolving Fund

UGT has set aside approximately US\$300,000 as part of the grants from the Gatsby Charitable Foundation, to be used to guarantee first-time borrowers (clients of UGT) from the Co-operative Bank. The lending which is made through the 'Uganda Co-operative Bank' is based on peer-

group pressure. For a second loan, the enterprise should be able to borrow from the bank like any other regular customer.

The funds are deposited on a fixed deposit in the bank and earn the Trust some 12 per cent interest per annum. The bank lends 'own' funds to the UGT and client SMEs and operates the loan scheme, but requires the guarantee of UGT since most client SMEs do not have physical collateral.

UGT has been providing soft loans to the SME sector for the past three years. The recovery rate of these loans has been high, probably because of the inbuilt safeguards in the process. Members of the club have to operate in groups/clubs; they must encourage loan beneficiaries to honour their obligations. If any members of the group/club mismanage a loan, they effectively frustrate the chances of other members of the same group from receiving a loan. Specifically, the recovery rate stands at about 90 per cent.

Technology Consults Limited (TECO)

The financial management of TECO is vested in the Business Manager, who is a faculty staff member, and the Board of Directors. Since the membership of TECO is comprised of staff in the Faculty of Technology, the Dean of the faculty and the Business Manager are the two signatories to the Account. TECO is audited annually by an approved competent firm in Kampala.

TECO profits

TECO has continued to register some profits ever since it was established in 1992. Below, in Table 4, is a brief summary of these profits in the period 1992 to 1997.

Table 4. TECO profits during 1992 to 1997

Year	1992	1993	1994	1995	1996	1997
Profit C/D (US\$1=1,100 Uganda shillings)	174,850	1,420,116	5,250,625	9,790,931	17,127,510	33,765,875

Start-up capital

TECO has accumulated a start-up capital of about U.Shs. 17 million, which is used in project assessment, initial designs of projects and production of bills of quantity, travel, report production, computer-aided designs (CAD), expenses, etc.

Costing of services

University work contracted by TECO is generally carried out at 20 per cent less the cost at open-market bidding. This is because, at present, Uganda is at full speed with the privatization process recommended by the IMF and the World Bank. Due to intense competition, it is important to keep the profit margin low so as to become competitive. Further, the quality/skills of workers are not very high, and therefore the products are not of the high grade required by a competitive market.

For Makerere University, it has been difficult to penetrate the market, because of the public perception that a university produces knowledge, but is not involved in production services.

Also, university consultants have been shy in costing up their services/fees appropriately, to streamline them with the outside market. Consequently, costs and goods produced in the university are cheaper than those manufactured outside.

For the detailed calculation of prices, Gatsby Trust and TECO use the full cost model (see Box 1). In the case of training services, the cost covers fees, per diem, factory/enterprise visits, welfare, venue, publicity, transport and documentation.

Box 1. Example of a full cost calculation of a training course

Below is an average cost for one (1) training course (For instance, 30 participants for 5 days and 4 facilitators).

Item	Quantity	Rate (Shs)*	Total (Shs)*
Fees	5 days	640,000	3,200,000
Per diem	20 days	60,000	1,200,000
Factory visits	1	200,000	200,000
Welfare	200 meals	5,000	1,000,000
Publicity	1	300,000	300,000
Documentation			800,000
Transport	500 per km.	-	-

On average its cost is about Shs.260,000 to train one person.

*US\$1 = Shs.1,300

Facilitators are paid Shs.160,000 per day (see item on fees).

A new thinking has emerged within the university management that any consultancy carried out by the academics should involve the contribution of a percentage to the university, as the academics use the name and resources of the university. This is yet to be discussed by the University Council, which is the governing body for policy formulation and implementation.

It is also worth mentioning that consultancy fees must be in line with and adhere to the governing Uganda Institution of Professional Engineers' (UIPE) conditions of engagement and scale of fees. It is important that fairness is exercised to the satisfaction of all parties involved. The Board of TECO decided to offer a discount of about 20 per cent to educational institutions and religious organizations.

Distribution of generated income

Income generated from the consultancy services is shared among the consultants (that is, the faculty staff) who work on a specific project, the faculty administration (to pay for wear and tear of equipment), and the Makerere University Central Administration. At present, 51 per cent of the net income of any work executed and completed goes to the consultants who perform the work, 30 per cent is for TECO shareholders, 12 per cent to the Central Administration of the university, and 7 per cent to the project administration. No specific share goes to the departments because staff members are the main consultants and they belong to the departments. This arrangement was set up with the rationale to encourage staff members to stay in the faculty and train the students, instead of looking for work elsewhere to supplement their meagre salaries.

Recently, shareholders have expressed a wish to review these figures. The proposal is to have the central administration retain only 5 per cent and the shareholders to receive about 25 per cent. In future, possibly, if projects requiring intensive utilization of departmental equipment are embarked on, the issue of depreciation costs will have to be addressed.

Financing of students' involvement in consultancy services

Students participate in TECO and UGT as trainees. This takes place during official industrial training. In the case of UGT, funds are set aside to cover transport, living expenses at the training sites, and the preparation of reports. In the case of TECO, students as trainees are given subsistence allowances to cover transport, accommodation during holidays, and lunch.

4.4 Promotion avenues

The University Appointments Board still requires academic papers published in international journals for promotion. This requirement has greatly stalled the promotion of senior deserving members in science-based disciplines.

Many faculty members have continued to do excellent work with industries and, indeed, work of local relevance. Unfortunately, the present system does not recognize it for promotion.

Recently, however, faculty Boards have demanded redress and revision of some of the old requirements for promotion. Senate is yet to deliberate on submissions from faculties.

4.5 Rules with regard to codes of conduct of staff involvement in university-industry collaboration

Any academic who intends to work, or works with industry or any other organization outside the university, must satisfy a weekly minimum teaching workload of eight hours. The period may seem low, but there are a number of reasons for this.

- The university expects lecturers to prepare laboratory work, tutorials, consultations with students, and marking (continuous assessment). This is important to maintain quality.
- Academics are supposed to do research as this is the basis for academic growth and promotion in this university.
- Academics are also involved in fieldwork (in the case of technology, industrial training for undergraduates is a partial requirement for graduation).

However, the university encourages staff to undertake consultancies that are mutually beneficial to both the academics and the university.

At Makerere University, staff are expected to fulfil their traditional teaching and research requirements. There are, however, no specific rules specifying maximum amounts of time that may be devoted to collaborative work with industry.

5. Success factors in the operation of TECO and UGT interfaces

In carrying out the activities of TECO, staff members and personnel from industries have worked together on a number of industry-based projects. From an industry perspective, they have a contact point where specialized facilities and specialist members of staff can be found. Also, TECO has a commitment to deliver on time at a lower cost.

On the other hand, faculty members are not only rewarded financially, but have benefited from working in their respective areas of specialization.

In the case of TECO, the following achievements have been realized:

- Professional skills of the academic staff might well have been enhanced.
- Greater appreciation of problems of a local nature has been achieved.
- Students have been trained in consultancy skills.
- Increased income of academic staff members has reduced brain drain.
- Staff members have been kept busy in-house, thereby increasing their interaction time with students.
- Industries have increased their interaction time with the university (faculty).
- In future, industries will be encouraged to endow Chairs and also support research and development.

With respect to UGT, collaboration with industry has had the following impact:

- UGT has enabled the university engineering students and staff to interact closely with small-scale enterprises and the informal sector.
- UGT has improved the image of small-scale enterprises in the eyes of the graduate engineers, a feat which has led to attitudinal change.
- UGT extends loans to small-scale enterprises even in the absence of adequate collateral.
- UGT has promoted the image and role of the university in the public eye. The traditional 'ivory tower' image of the university is slowly being replaced by interactive innovations and appreciative actions between all the partners involved.
- The long reach of UGT, through UGT Clubs, is having a major impact on small towns upcountry.

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The book

Nowadays, the existence of relations between higher education institutions and industry has become a common and more widely acceptable phenomenon. It is also generally acknowledged that professional management of university-industry relations is a crucial success factor for the development of sustainable collaboration.

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The editor

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